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MINERALS YEARBOOK

Area Reports: International 1997

Africa and the Middle East

Part I
Volume III

USGS
science for a changing world

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Foreword

This edition of the U.S. Geological Survey (USGS) Minerals Yearbook discusses the performance of the worldwide minerals and materials industries during 1997 and provides background information to assist in interpreting that performance. Content of the individual Minerals Yearbook volumes follows:

- Volume I, Metals and Minerals, contains chapters about virtually all metallic and industrial mineral commodities important to the U.S. economy. Chapters on survey methods, summary statistics for domestic nonfuel minerals, and trends in mining and quarrying in the metals and industrial minerals industries in the United States are also included.
- Volume II, Area Reports: Domestic, contains a chapter on the mineral industry of each of the 50 States and Puerto Rico and the Administered Islands. This volume also has chapters on survey methods and summary statistics for domestic nonfuel minerals.
- Volume III, Area Reports: International, is published as four separate reports. These regional reports contain the latest available minerals data on more than 190 foreign countries and discuss the importance of minerals to the economies of these nations and the United States. Each report begins with an overview of the region's mineral industries during the year. It continues with individual country chapters that examine the mining, refining, processing, and use of minerals in each country of the region and how each country's mineral industry relates to U.S. industry. Most chapters include production tables and industry structure tables, information about Government policies and programs that affect the country's minerals industry, and an outlook section.

The USGS continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the Minerals Yearbook are welcomed.

Charles G. Groat, Director

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Contacts

Information about the U.S. Geological Survey, its programs, staff, and products may be accessed on the World Wide Web at URL http://www.usgs.gov/ or by contacting the Earth Science Information Center at 1-888-ASK-USGS. For specific information about this publication, contact the Chief, International Minerals Section, Minerals Information Team, at (703) 648-7732 or the Chief, Publication Services Section, Minerals Information Team, at (703) 648-4750. Additional minerals information may be accessed on the World Wide Web at http://minerals.usgs.gov/minerals/.

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Acknowledgments

The U.S. Geological Survey Country Specialists, in preparing the International Review regional books of Volume III of the Minerals Yearbook, extensively use statistics and data on mineral production, consumption, and trade provided by various foreign Government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations are gratefully acknowledged. Statistical and informational material was also obtained from reports of the U.S. Department of State, United Nations publications, and the domestic and foreign technical and trade press. Of particular assistance were reports submitted by the Regional Resource Officers other officials of the Department of State in U.S. Embassies worldwide. Their contributions are sincerely appreciated. Internal statistical support was provided by the staff of the Data Collection and Coordination Section of the Minerals Information Team.

The regimes of some countries reviewed in this volume may not be recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not to be construed as conflicting with or being contradictory of U.S. foreign policy.

John H. DeYoung, Jr.
Chief Scientist, Minerals Information Team

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THE MINERAL INDUSTRIES OF

AFRICA

By George J. Coakley, Bernadette Michalski, and Philip M. Mobbs

The 55 independent nations and other territories of continental Africa and adjacent islands covered in this volume were home to 763 million people and encompass a land area of 30.3 million square kilometers, more than three times the size of the United States. For many of these countries, mineral exploration and production constitute significant parts of their economies and remain keys to future economic growth. The continent is richly endowed with mineral reserves and ranks first or second in terms of mineral concentration (about 20% to 89%) of world reserves of bauxite, chromite, cobalt, diamond, gold, manganese, phosphate rock, platinum-group metals, titanium minerals (rutile and ilmenite), vanadium, vermiculite, and zirconium.

In 1997, Africa witnessed a continued revival of mineral exploration and development stimulated by changes in the political climate that have enabled Angola and Mozambique to be reopened to exploration after years of civil war; a post-Apartheid South Africa looking outward toward the rest of Africa for mineral investment opportunities; efforts to privatize previously state-owned mineral holdings, such as the Zambia Consolidated Copper Mines (ZCCM); and the liberalization of mining and foreign investment laws in many countries. According to the Metal Economics Group of Halifax, Nova Scotia, Canada, $662.6 million was expended in Africa; compared with the $418 million spent on exploration in Africa in 1996, this was the largest percentage growth in exploration expenditure of any region in the world. In addition, plans for more than $18 billion in potential new mineral developments in the region were announced, although realization of this full investment is contingent on completion of due diligence and political risk assessments for a number of announced projects.

The major targets of mineral exploration in Africa were the more easily mined surface deposits of diamond and gold; the availability of project funding shrank, however, as the year progressed. By yearend, the price of gold declined by 15%, battered by considerable sales of gold reserves by a number of Government central banks; increased gold mine production; and, in the later half of the year, reduced demand from Asia. Additionally, the negative impact on the global financial market of the 1997 sample enrichment (salting) scandal and alleged stock fraud associated with the Busang gold deposit in Indonesia by Bre-X Minerals Ltd. of Canada completely eclipsed the 1996 salting scandal at the Sitakili property in Mali by Timbuktu Gold Corp. of Canada and made it more difficult for the junior exploration and mining companies to raise risk capital. Civil war disrupted a number of African nations, including the Democratic Republic of the Congo [Congo (Brazzaville)], the Republic of the Congo [Congo (Kinshasa); formerly Zaire], Sierra Leone, and Sudan. Civil strife or military unrest affected sections of Algeria, Burundi, the Central African Republic, Nigeria, Rwanda, Senegal, Somalia, and Uganda.

In the case of mineral commodities, six African countries were considered to be major import sources for the U.S. mineral industry. Among these were Gabon for manganese; Guinea for bauxite; Madagascar for graphite; South Africa for antimony, ferrochromium, ferromanganese, fluorspar, platinum-group metals, and vanadium; Zambia for cobalt; and Zimbabwe for ferrochromium. In terms of imports of crude oil by the United States, Nigeria (5th among all crude oil importers, at 252 million barrels), Angola (6th), Gabon (10th), Congo (Brazzaville) (18th), and Egypt (19th) were among the largest suppliers. Algeria was the fourth largest supplier of petroleum products.

Much of the mineral exploration and development interest was directed toward southern Africa. The deep waters off the countries along the southwestern coast, including Angola, Cameroon, Congo (Brazzaville), Congo (Kinshasa), Gabon, and Namibia, remained an active petroleum exploration prospective area. Coal was produced by only a few countries in Africa, although reserves are quite large in southern Africa. South Africa was the world's third largest coal exporter.

With the return of foreign investment, two new diamond projects in Angola, the Luo and the Catoca kimberlite, came into commercial production. Official total diamond production was expected to increase significantly to nearly 5 million carats per year within 2 to 4 years. Two offshore petroleum discoveries, Cabinda Gulf Oil Co.'s Kuito and Elf Aquitaine Group's Dahlia Fields, were announced in 1997, as was the confirmation of Elf's Girassol Field. The Dahlia Field was estimated to contain more than 2 billion barrels. In 1997, Angola was the fifth largest producer of crude petroleum in Africa.

In Botswana, diamond exploration continued, as did gold exploration and gold mine development. A new mining law was being prepared. Diamond production increased when the diamond mines switched from a 6-day work week to 7-day-per-week operations. The open-pit operation at Martin's Drift became the country's fourth diamond mine, but the Monarch gold mine was closed because of the drop in the price of gold.

Gold production from northeastern Congo (Kinshasa) was severely disrupted by the civil war that ended in May 1997 when a new Government was installed. Gold output dropped to 394 kilograms (kg) in 1997 from 8,200 kg in 1996. By the end of the year, 10 companies had entered joint ventures with state-owned mining companies to revitalize the copper-cobalt, gold, manganese, and zinc industries. Potential investment, subject to a return to political stability, could exceed $2 billion.

Exploration for diamonds in the Liqhobong kimberlite pipes in Lesotho continued. In Mozambique, nearly $12 billion in new mineral and infrastructure development projects were being considered by the Government and foreign investors in 1997. Proposed new investment included an aluminum smelter, a direct reduced iron plant, hot-briqueted iron plant, a steel plant, three titanium mining and processing operations, reopening the Moatize coal mine, and development of the Buzi-Divinhe, the Pande, and

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the Temane natural gas fields and associated pipelines.

In Namibia, new Government policies have brought in a new wave of foreign investors interested in offshore diamond production, major capital investment was secured to upgrade the Rössing open-pit uranium mine, and the proposed development of the $600 million Haib copper and the $164 million Scorpion zinc deposits were under consideration. Copper and lead production dropped sharply since the closure of the Tsumeb Mine in 1996.

In South Africa, more than $2.5 billion in planned new investment was proposed for a number of mineral industry projects, including the expansion of the Richards Bay coal export terminal and the Namakwa Sands titanium project, the modernization of Aluminium South Africa (Pty.) Ltd.'s Bayside aluminum smelter at Richards Bay and Iscor Ltd.'s aging steel plant at Vanderbijlpark, and the construction of a second coal terminal and associated infrastructure at Richards Bay, a $1.5 billion 1.25-million-metric-ton-per-year (Mt/yr) steel plant at Saldhana Bay, an underground mine at the Palabora copper operation, a new titanium mine and plant near Richards Bay, and a new zirconium basic sulfate plant at Palabora.

Since 1994, the industry has been undergoing a major corporate restructuring, or "unbundling," aimed at simplifying a complex system of interlocking ownership, establishing separate core-commodity-focused profit centers, and diversifying and rationalizing nonperforming assets to make the newly restructured companies more competitive internationally. Anglo American Corp. spun off all its platinum-group metals operations as Amplats. JCI Ltd.'s major gold mines, chiefly H.J. Joel, were merged with Anglogold's operations to form the largest gold producer in the world with a production capacity of 187 metric tons per year (t/yr) of gold. JCI Ltd. was then split into JCI Projects and JCI Gold, with the latter retaining the Randfontein Estates and the Western Areas gold properties. In November 1997, Gencor Ltd. and Gold Fields of South Africa Limited announced their merger into a single company, Gold Fields Ltd., that will be the second largest gold producer in the world.

Although South Africa was the dominant gold producer in the world in 1997, gold production, at about 492 metric tons (t), was the lowest in 41 years. The extreme depths of new gold deposits in South Africa will add several years to underground development time. Four new major deep gold projects continued on track; namely, Avgold's Target project, JCI/Western Areas South Deep project, Anglogold's Moab project, and the development of Gold Field's Oryx Mine. The Oryx Mine, which was commissioned in 1996, was expected to produce at full capacity of 10,550 kilograms per year of gold by 1999.

The Nkomati nickel mine began commercial production in 1997, as did the country's first offshore oilfield, Oribi. The new Mine and Safety Act went into effect in 1997, and the Government was preparing new Environmental Management Policy and Minerals and Mining Policy papers.

In Zambia, privatization of state-owned coal and copper operations was underway. The Zambian Privitization Agency had divided the state copper company, ZCCM, into nine entities and offered them separately. During 1997, ZCCM successfully divested its controlling ownership in the Luanshya Division; the Chambishi, the Chibuluma, and the Kansanshi copper mines; and the Power Division. The state-owned Maamba coal colliery was also sold. Zambia gained more than $320 million in sales and new foreign investment commitments under these transactions; if new mines are developed at Konkola and Kansanshi, then Zambia can expect substantial additional foreign investment in the future. A consortium of U.S., Canadian, and South African mining companies was negotiating to acquire the Nkana and the Nchanga Divisions, representing more than 50% of national copper production. A plant at Nkana to recover cobalt from stockpiled smelter slag was opened in 1997, as was the Dunrobin gold mine.

Despite the drop in the price of gold, gold exploration and mine development continued in Zimbabwe. Many small-scale gold mines were operating and a significant number of people were involved in informal gold panning. Despite the opening of the Bubi and the Beehive gold mines, national gold output failed to increase for the first time in years. The major gold mining companies were restructuring their operations, and the number of gold mine closures increased as the gold price dropped. The Asian financial crisis was blamed for the drop in demand for asbestos and ferrochromium, for which Zimbabwe was a major contributor to the world supply. The Hartley platinum mine was commissioned in June, and the first platinum-group metal shipment from the operation was made in October. A base metals refinery also was opened at Hartley. Buchwa Iron Mining Co. (BIMCO) commissioned its sinter plant at Redcliff, and the rehabilitation of the No. 4 blast furnace of BIMCO's parent, Zimbabwe Iron and Steel Company (Pvt.) Ltd., got underway. In 1997, the Government sent out mixed signals by proposing partial divestment of state-owned mineral companies while pursuing an indigenization policy to increase local interest in multinational mining operations.

In West Africa, gold exploration continued in Benin, Burkina Faso, the Central African Republic, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, and Senegal. The search for oil continued with exploration offshore of Benin, Côte d'Ivoire, Equatorial Guinea, Ghana, Guinea-Bissau, Nigeria, and Senegal. Burkina Faso got a new mining code, and Benin, Cameroon, and Liberia were revising or reviewing their mining laws.

In Guinea, the dispute within the ownership consortium of Société d'Economie Mixte Friguia bauxite and alumina operation resulted in the company being declared bankrupt by the Government. The Government was studying the restructuring of its interest in the bauxite industry. Besides gold and diamond exploration, there also was bauxite, iron, and nickel exploration during 1997.

In Ghana, the Damang and the Obotan gold mines were brought into production during 1997; the Wassa, the Bibiani, and the Tarkwa gold mines were scheduled to startup in 1998. Because of the major domestic energy crisis, Ghana was examining alternatives to its irregular hydroelectric power, most likely a new natural-gas-powered plant. As a result of the energy shortages, the Volta Aluminum Co. Ltd. aluminum smelter operated at only 20% of capacity during the year. The Government declared a 6-month moratorium on prospecting and reconnaissance licenses.

The Sadiola Hill gold mine, which began operations in 1997, significantly increased Mali's gold production. Diamond, gold, and oil exploration continued in Mali. Exploratory drilling for oil was underway in Niger. In Nigeria, Africa's largest oil producer and the world's ninth largest producer of crude oil by volume, the Government was encouraging the diversification of the mineral industry. Interest in mineral development increased at the local level. The Government was trying to formalize operations at mineral deposits developed by unlicensed small-scale miners and

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was considering restructuring its interest in state-owned mineral concerns. During 1997, the Aluminum Smelter Co. of Nigeria started one potline, a liquefied petroleum gas extraction plant was opened at Escravos, and the Ima and the Ukpokiti oilfields came on-stream.

Gold was the object of exploration efforts and mine development in the eastern African countries of Djibouti, Eritrea, Ethiopia, Kenya, Tanzania, and Uganda. International and local petroleum companies explored oil and natural gas prospects offshore Eritrea and Mozambique. Kenya, Tanzania, and Uganda were revising or reviewing their mining laws. The Ethiopian Government privatized the Lega Dembi gold mine and put the Adola gold placer operation up for bids. Bids were also solicited for the petroleum refinery in Madagascar.

The petroleum refinery in Eritrea was closed for renovation. In Ethiopia, a kaolin mine and a feldspar and quartz mine were opened. A 730,000-t/yr cement plant was under construction near Mekele, in northern Ethiopia. Phelps Dodge Corp. announced discovery of a nickel laterite deposit in Madagascar. In Tanzania, exploration results through the end of 1997, as reported by seven of the most active operators, identified approximately 300 t (9.6 million troy ounces) of drill measured and indicated gold resources and an additional 250 t (8.1 million troy ounces) of inferred gold resources. Given the depressed level of gold prices, companies have been cautious about moving exploration results from the resource to the reserve category until full bankable feasibility studies have been completed. The majority of discoveries to date have been focused on near-surface deposits grading from 2 grams per ton (g/t) to 5 g/t. One deeper high-grade deposit with grades ranging from 12 to 14 g/t was reported at Bulyanhulu. The Government remained optimistic that several of these projects will be brought into production during the next 5 years. In November 1997, construction began on the $47 million Golden Pride gold development.

In northern Africa, Libya was the second largest producer of crude petroleum in Africa, followed by Algeria and Egypt. Petroleum exploration continued in Algeria, Egypt, Libya, Mauritania, Morocco, and Tunisia. There was a natural gas discovery in Morocco, and several new petroleum discoveries in Algeria were being evaluated for commercial production. In Egypt, in 1997, there were 15 oil and 20 natural gas discoveries, and the Abu Tartor phosphate mine was opened. Morocco was the third leading phosphate rock producer in the world. Gold exploration continued in Egypt, Mauritania, and Morocco. Exploration for diamond was active in Mauritania. Société Nationale de Sidérurgie opened a new steel billet plant in Morroco. Alexandria National Iron and Steel Co. completed an expansion to raise capacity to 1.6 Mt/yr. Of the state-owned Aluminum Co. of Egypt, 20% was offered to employees and investors.

Natural resource development has proved vital to the economies of African nations because of its role in generating employment and foreign exchange and in providing the stimulus to develop the power and transportation infrastructure of the region.

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TABLE 1
AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1997 1/

(Thousand metric tons unless otherwise specified)

Country	Alumi-num e/	Cement e/	Chromite	Coal, anthracite and bitu-minous	Cobalt, mine Co con-tent e/ (metric tons)	Copper, mine Cu con-tent	Diamond (thousand carats) e/ 2/	Gold e/ (kilograms)
Algeria	--	6,900	--	22 e/	--	--	--	--
Angola	--	301 3/	--	--	--	--	1,234 3/	--
Benin	--	550	--	--	--	--	--	--
Botswana	--	--	--	777	348 3/	23	20,111 3/	28 3/
Burkina Faso	--	--	--	--	--	--	--	1,450
Burundi	--	--	--	--	--	--	--	10
Cameroon	82	600	--	--	--	--	--	1,000
Central African Republic	--	--	--	--	--	--	500	90
Congo (Brazzaville)	--	121	--	--	--	--	--	10
Congo (Kinshasa)	--	125	--	50	3,500	40	22,200	394
Cote d'Ivoire	--	500	--	--	--	--	307 3/	2,419 3/
Egypt	178 3/	19,700 3/	1	300 e/	--	--	--	--
Equatorial Guinea	--	--	--	--	--	--	--	--
Eritrea	--	50 3/	--	--	--	--	--	350
Ethiopia	--	700	--	--	--	--	--	3,000
Gabon	--	200	--	--	--	--	500	70
Ghana	152	1,400	--	--	--	--	715 3/	54,446 3/
Guinea	--	--	--	--	--	--	205	7,000
Kenya	2	1,000	--	--	--	--	--	300
Liberia	--	--	--	--	--	--	150	500
Libya	--	3,500	--	--	--	--	--	--
Madagascar	--	60	137 p/	--	--	--	--	500
Malawi	--	140	--	56	--	--	--	--
Mali	--	10	--	--	--	--	--	19,000
Mauritania	--	125	--	--	--	--	--	200
Morocco	--	8,000	--	506	722 3/	15 e/	--	450
Mozambique	--	200	--	30	--	--	--	100 3/
Namibia	--	--	--	--	--	20	1,416 3/	2,433 3/
Niger	--	30	--	140	--	--	--	1,000
Nigeria	3	6,000	--	7 e/	--	--	--	6
Rwanda	--	10	--	--	--	--	--	26
Senegal	--	590	--	--	--	--	--	--
Sierra Leone	--	--	--	--	--	--	104	10
Somalia	--	30	--	--	--	--	--	--
South Africa	673 3/	7,490 3/	5,740	218,617	450	153	10,041 3/	491,680 3/
Sudan	--	380	10 e/	--	--	--	--	5,000
Swaziland	--	--	--	203	--	--	70	--
Tanzania	--	800	--	35	--	--	116	300
Togo	--	350	--	--	--	--	--	--
Tunisia	--	4,431 3/	--	--	--	--	--	--
Uganda	--	150	--	--	--	--	--	3,000
Zambia	--	384	--	10	4,386	353 e/	--	290
Zimbabwe	--	965	670 e/	5,301	100	9 e/	421 3/	24,244 3/
Total, Africa 4/	1,090	65,792	6,558	226,054	9,506	613	58,090	619,306
Total, world	21,400	1,551,000	12,500	4,734,009	27,000	11,400	109,900	2,420,000
Share of world total	5%	4%	52%	5%	35%	5%	53%	26%
United States	3,600	84,244 3/ 5/	--	988,770	--	1,940	4	360,000

See footnotes at end of table.

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TABLE 1--Continued
AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1997 1/

(Thousand metric tons unless otherwise specified)

Country	Iron ore (gross weight)	Lead, mine Pb content (metric tons)	Manganese ore (gross weight)	Petroleum, crude (thousand barrels)	Phosphate rock e/ (gross weight)	Steel, crude e/	Uranium, concentrate U_3O_8 6/ (metric tons)	Zinc, mine Zn content (metric tons)
Algeria	2,250 e/	1,000 e/	--	466,100	1,068 3/	427 3/	--	6,000 e/
Angola	--	--	--	262,800	--	--	--	--
Benin	--	--	--	1,100 e/	--	--	--	--
Botswana	--	--	--	--	--	--	--	--
Burkina Faso	--	--	1 e/	--	--	--	--	--
Burundi	--	--	--	--	--	--	--	--
Cameroon	--	--	--	33,000	--	--	--	--
Central African Republic	--	--	--	--	--	--	--	--
Congo (Brazzaville)	--	--	--	64,000 e/	--	--	--	--
Congo (Kinshasa)	--	--	--	10,600	--	--	--	--
Cote d'Ivoire	--	--	--	5,334	--	--	--	--
Egypt	2,700	--	10	319,000	900 3/	2,717 3/	--	--
Equatorial Guinea	--	--	--	7,300	--	--	--	--
Eritrea	--	--	--	--	--	--	--	--
Ethiopia	--	--	--	--	--	--	--	--
Gabon	--	--	1,904	134,000	--	--	557	--
Ghana	--	--	1,000	--	--	10	--	--
Guinea	--	--	--	--	--	--	--	--
Kenya	--	5	--	--	--	20	--	--
Liberia	--	--	--	--	--	--	--	--
Libya	--	--	--	516,475	--	--	--	--
Madagascar	--	--	--	--	--	--	--	--
Malawi	--	--	--	--	--	--	--	--
Mali	--	--	--	--	--	--	--	--
Mauritania	11,700	--	--	--	--	5	--	--
Morocco	12	77,056	29	35	23,084 3/ 7/	7	--	89,248
Mozambique	--	--	--	--	--	--	--	--
Namibia	--	13,577	40	--	--	--	3,426	40,519
Niger	--	--	--	--	--	--	4,124	--
Nigeria	50 e/	--	--	800,000	--	--	--	--
Rwanda	--	--	--	--	--	--	--	--
Senegal	--	--	--	2 e/	1,340	--	--	--
Sierra Leone	--	--	--	--	--	--	--	--
Somalia	--	--	--	--	--	--	--	--
South Africa	33,225	83,114	3,153	4,380	2,732	8,311	1,297	71,062
Sudan	--	--	--	6,000	--	--	--	--
Swaziland	--	--	--	--	--	--	--	--
Tanzania	--	--	--	--	3	--	--	--
Togo	--	--	--	--	2,200	--	--	--
Tunisia	252	1,420	--	26,841	6,941 3/	195 3/	--	2,967
Uganda	200	--	--	--	--	15	--	--
Zambia	--	--	--	--	--	--	--	--
Zimbabwe	479	--	--	--	125	240	--	--
Total, Africa 4/	50,868	176,172	6,137	2,656,966	38,393	11,947	9,404	209,796
Total, world	1,040,000	3,010,000	22,700	24,243,300	138,000	795,000	42,092	7,460,000
Share of world total	5%	6%	27%	11%	28%	2%	22%	3%
United States	63,000	459,000	--	2,354,980	45,400	94,651 3/	2,559	632,000

e/ Estimated. p/ Preliminary.
1/ Data may be different from that appearing in individual country production tables owing to availability of more current data. Table includes data available through January 1, 1999.
2/ Excluding synthetic diamond.
3/ Reported figure.
4/ May not add to totals shown because of independent rounding.
5/ Includes Puerto Rican data.
6/ Source: The Uranium Institute, London, England, written commun., 1999.
7/ Includes production from Western Sahara.

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THE MINERAL INDUSTRY OF

ALGERIA

By Bernadette Michalski

Hydrocarbons remained the leading mineral sector, accounting for $13.6 billion, or 96.5%, of total Algerian export revenues in 1997 (Arab Petroleum Research Center, 1998, p. 18-58). Production of metals and industrial minerals was modest. The minerals industry supplied 16% of the gross domestic product (Mining Journal, 1998). The Office de Recherche Géologique et Minières (ORGM) was responsible for the promotion of international investment in the Algerian mineral industry. Although several exploitable mineral deposits have been identified by ORGM, they were located in remote areas lacking infrastructure.

The Government's development priorities included expanding exploration activities, improving the recovery rate of oil and gas, augmenting hydrocarbon reserves, and increasing hydrocarbon production, transport, and export capacities. A production-sharing agreement with Atlantic Richfield Co. of the U.S. (ARCO) was Algeria's first association with a foreign partner in exploiting a producing field, the Rhourde El Baguel. The agreement permits ARCO to receive up to 49% of the field's output. In 1997, ARCO's share of production was 17,100 barrels per day (bbl/d) compared with 6,300 bbl/d in 1996, the first year of the partnership. ARCO's use of in-fill drilling and miscible gas injection technology was expected to add 50 to 100 million barrels (Mbbl) to the field's recoverable reserves between 1997 and 2000. The field was expected to reach peak production of 125,000 bbl/d by the close of the century.

Since the decree of April 6, 1996, a foreign company engaged in hydrocarbon exploration and development is no longer required to form a commercial company subject to Algerian law with headquarters in Algiers if it sets up a joint stock company with the Government's Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH). If a field has not yet been developed or is under development, then the foreign company is required to pay a bonus to access reserves. If a foreign company finances a pipeline, then priority will be given to transporting hydrocarbons from the field operated by that company. SONATRACH's foreign partners have the right to use the proceeds of natural gas exports covered by joint marketing agreements with SONATRACH. The foreign partners are not required to return their share of proceeds from these sales to Algeria.

In 1997, crude oil production was 847,000 bbl/d compared with 812,000 bbl/d in 1996. Lease condensates were produced at an average of 430,000 bbl/d in 1997 and 1996. The production of natural gas plant liquids averaged 145,000 bbl/d, slightly below 1996 levels (Energy Information Administration, 1998a, p. 8, 41-42). A variety of nonfuel minerals were produced in minor amounts, but only iron ore, mercury, and phosphate rock outputs were significant. All iron ore produced was consumed domestically. Phosphate rock and mercury were produced entirely for export. Algerian production of mercury has fluctuated widely along with the price of this commodity in the world market. *(See table 1.)*

Natural gas and liquid fuels accounted for the bulk of Algeria's export earnings. Exports of natural gas totaled 52 billion cubic meters in 1997. Expanded export volumes and favorable prices through most of 1997 resulted in an almost 9% increase in earnings. Italy continued to be the principal market for Algerian natural gas, followed by France, Spain, Belgium, Turkey, and others, in order of volume. Algeria's share of the European gas market ranks third behind Russia with 36% and the Netherlands with 26%. Liquefied natural gas (LNG) exports were directed principally to Europe and the Western Hemisphere. In 1997, the United States imported 1.86 billion cubic meters, nearly double the amount of LNG imported from Algeria in 1996. Two-thirds of the Algerian LNG arriving in the United States was received at the Distrigas Corp. terminal north of Boston at Everett, Massachusetts. The remaining LNG was received at the Trunkline LNG Co. Terminal at Lake Charles, Louisiana. Most of Algeria's natural gas exports are sourced from the Hassi R'Mel Field (Energy Information Administration, 1998b, p. 14).

In 1997, nearly 230 Mbbl of Algerian crude oil and refined products were exported to Western Europe and 104 Mbbl were exported to the United States. Nearly one-half of the U.S. imports from Algeria were slated as feedstock for the petrochemical industry (Energy Information Administration, 1998c, p. 83). Other mineral exports from Algeria included helium, iron ore, metals, liquid and gaseous nitrogen, and phosphates. *(See table 2.)*

Algeria's overall foreign trade surplus amounted to $5.74 billion in 1997 compared with the $4.28 billion reported in 1996. The higher trade surplus enabled Algeria to improve its financial situation despite its heavy external debt burden. Any decline in oil prices, however, has serious implications for the Government's domestic finances. The average spot price for Algeria's Saharan Blend crude oil was slightly higher at $21.35 per barrel in 1997 compared with $21.27 per barrel in 1996.

Entreprise d'Exploitation des Mines d'Or (ENOR), the state gold development company, has initiated fund raising for the development of the Tamesmessa and the Tirek gold deposits in southern Algeria. Government funding for the ENOR project will come from SONATRACH, and the Algerian Central Bank, $6 million each; SAA (Algeria's insurance company), $3 million; and ENOR, $1.5 million. Completion of the project is expected to cost $40 million. Foreign capital is expected to finance the remaining $23.5 million (OPEC Bulletin, 1997).

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Helium is produced at the Helios Co.'s Bethious plant, near Arzew. SONATRACH owns a 51% equity in the company, and Air Products & Chemicals, Inc., of the United States and L'Air Liquide of France share the remaining equity. Virtually all production is exported to Europe. The plant's capacity is 16 million cubic meters per year of liquid helium, accounting for 20% of world output and 33,000 metric tons per year of liquid and gaseous nitrogen. A feasibility study was undertaken covering the possible construction of the nation's second helium plant.

Anadarko Petroleum Corp. of the United States announced four oil and gas discoveries in 1997—El Merk Central in block 208, Qoubba North in block 404, Hassi Berkine South-East, and Hassi Berkine Central in block 404. Partners in the concessions are Lasmo of the United Kingdom and Maersk Oil & Gas of Denmark.

The Louisiana Land & Exploration Co. (LL&E) of the United States reported a fourth discovery in block 405 in May 1997 and a fifth discovery in the same block in December 1977. Broken Hill Proprietary, Ltd., of Australia reported discoveries in block 402a, one in May 1977 and another in September 1977. Petro-Canada reported a discovery in the Tinrhert block in December 1977. Commerciality of these finds was under assessment.

British Petroleum Exploration Operating Co., Ltd., continued survey work on the In Salah license area, which lies in the Sahara Desert 1,200 km south of Algiers. Survey plans include 2,000 line km of 2 dimensional and 750 km^2 of 3 dimensional seismic data.

Gross production of natural gas was nearly 129 billion cubic meters, about 50% of which was reinjected to maintain petroleum-reservoir pressure. The combined total production of LNG at the three liquefaction plants at Arzew, and the one at Skikda was about 85,000 cubic meters per day of LNG (Arab Oil and Gas Directory, 1998, p. 18-58).

Most of Algeria's crude oil production was derived from the Hassi Messaoud-Haoud El Hamra Fields in the Sahara and the Tin Fouyé Tabankort and the In Amenas Fields, near the Libyan border.

Combined refined petroleum product output averaged about 445,000 bbl/d from four refineries. Algeria's petroleum-refining capacity was 462,300 bbl/d, including Skikda with capacity at 323,400 bbl/d; El Harrach, 58,200 bbl/d; Arzew, 54,000 bbl/d; and Hassi Messaoud, 26,700 bbl/d.

The national petrochemicals company, ENIP, has established a joint venture with Repsol of Spain to construct linear low-density polyethylene, polyvinyl chloride, and high-density polyethylene plants. To support this development, the Algerian Government has provided investment guarantees that include provision of public utilities and raw materials and preferential tax treatment. (U.S. Embassy, Algiers, Algeria, 1997)

Hydrocarbon reserves in January 1998 were 3.7 trillion cubic meters of natural gas. Unassociated natural gas accounted for 85% of these reserves. Recoverable petroleum reserves were reported to be 9.2 billion barrels (Arab Petroleum Research Center, 1998).

Algeria's railroad system, which totaled 4,060 km of track, and its road network, which covered more than 90,000 km, were in the northern section of the country and supported long-established mining and other export-oriented industries. The existing infrastructure was too distant to lend support to the development of commercial mineral deposits reported in the southern desert.

More than 11,400 km of pipeline served the hydrocarbon industries within Algeria. The center of the crude oil pipeline network was Hassi Messaoud, in the southeast, from which three crude lines ran north to Skikda, Bejaia, and Arzew. The center for the natural gas pipeline network was Hassi R'Mel, with pipelines connecting to liquefaction facilities at Arzew and Skikda. Hassi R'Mel was also the source for natural gas exports to southern Europe by means of the 24-billion-cubic-meter-capacity Trans-Mediterranean pipeline and the 8-billion-cubic-meter-capacity Maghreb-Europe pipeline. The Transmed natural gas export pipeline extended for 2,340 km from Algeria northeastward through Tunisia and under the Mediterranean Sea to Sicily and the Italian mainland. Natural gas was exported to Slovenia by means of a 35-km spur line near the Italian end of the Trans-Mediterranean pipeline. The 1,845-km Maghreb-Europe pipeline traverses Algeria northwestwards through Morocco and the Straits of Gibraltar to southern Spain. The pipeline was inaugurated in November 1996 at an initial capacity of 8 billion cubic meters per year. The second phase of the Maghreb-Europe pipeline construction will include extensions to Portugal, France, and Germany. Additional compressor stations could bring the pipeline capacity to 19 billion cubic meters per year, if commercial outlets warrant it.

Algeria used seven marine terminals for the export of hydrocarbons, including La Skhirra, in Tunisia. The largest terminal was Arzew-Bethioua, which accommodated 40% of all hydrocarbon exports. Port capacity at Skikda was limited to 90,000-cubic-meter LNG carriers. Efforts were underway to augment facilities to eventually accommodate 125,000-cubic-meter LNG carriers.

The Government has not only encouraged petroleum exploration, but has offered a portion of production rights in existing oil and gas fields to private companies providing capital and enhanced recovery technology. ARCO-Atlantic Richfield, Agip SpA, Anadarko, British Petroleum, Cepsa SA, Burlington Resources, Petro-Canada, Repsol, and Total SA were among the 18 companies working in Algeria under 21 exploration contracts active in 1997.

The country's dependence on hydrocarbon revenues will impact the economy in the near term as the petroleum prices that have been declining since November 1997 affect revenues. In future years, recoverable reserves should increase as a result of new discoveries, improved data on existing fields, and the installation of enhanced recovery systems. Nine promising hydrocarbon discoveries were reported in 1997. Although the delineation and appraisal work were not completed, preliminary data are favorable. Algeria's state oil company and foreign parties will invest $19.3 billion on field development and pipeline transportation through 2001. Exploration and development contracts should bring Algeria's crude oil capacity to 1.3 million barrels per day, and natural gas production should double in this time period (World Oil, 1997).

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TABLE 1
ALGERIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
METALS						
Cadmium, refined		65 r/	59 r/	50 r/	44 r/	40 3/
Iron and steel:						
Iron ore, gross weight	thousand tons	2,311	2,047	2,202 r/	2,245	2,250
Metal:						
Pig iron	do.	925	919	940	800 e/	700
Steel, crude	do.	865	808	827	641 r/	427 3/
Lead:						
Concentrate, Pb content		1,538	1,100	1,383	1,016	1,000
Metal, refined		6,000	8,000	7,500	8,600 r/	8,000
Mercury	kilograms	459,100	414,000	292,000	367,800	365,000
Silver e/	do.	2,200	3,000	2,000 r/	1,600 r/	1,500
Zinc:						
Concentrate, Zn content		6,800	5,700	7,174	5,912	6,000
Metal, smelter output		33,400	30,000	30,000	25,000 e/	25,000
INDUSTRIAL MINERALS						
Barite, crude		47,232	20,584	29,838	31,348	31,400
Cement hydraulic		6,400	6,060	6,822 r/	6,900 r/	6,900
Clays:						
Bentonite		20,833	20,215	17,088	17,200 e/	17,200
Fuller's earth		3,229	4,550	4,500	4,500 e/	4,500
Kaolin		12,586	16,984	24,068	25,000 e/	25,000
Diatomite		3,471	2,800	3,700	3,700 e/	3,700
Feldspar		6,500	6,900	7,000	7,000 e/	7,000
Gypsum 4/	thousand tons	225	225	250	250 e/	275
Helium, liquid	million cubic meters	--	--	10	15 e/	15
Lime, hydraulic e/		62,000	62,000	62,000	62,000	65,000
Nitrogen, N content of ammonia		380,000	243,000 r/	176,100 r/	149,900 r/	379,500 3/
Phosphate rock:						
Gross weight	thousand tons	718	730	1,596	1,051	1,068 3/
P_2O_5 content	do.	245	251	500	320 e/	325
Salt, brine and sea salt		179,000	178,000	250,000 r/	250,000 r/ e/	250,000
Sodium compounds, caustic soda e/		700	700	700	700	700
Strontium minerals, celestite, gross weight e/		5,400	5,400	5,400	5,400	5,400
Sulfur, elemental e/		20,000	20,000	20,000	23,000	23,000
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	20	20	22	22	22
Gas, natural:						
Gross	million cubic meters	133,700	131,100	114,779	122,600 r/	128,700 3/
Dry 5/	do.	53,900	51,100	58,100	62,300	65,000
Natural gas plant liquids	thousand 42-gallon barrels	52,925	51,500	53,000	54,750 r/	52,935 3/
Petroleum:						
Crude including condensate	do.	424,130	430,700	436,905	453,300	466,100 3/
Refinery products:						
Liquefied petroleum gas	do.	9,000	5,220 r/	8,000 r/	8,500 r/ e/	8,500
Gasoline	do.	20,988	18,900 e/	21,900	20,148	20,000
Naphtha e/	do.	30,000	31,000	31,000	31,000	31,000
Kerosene	do.	3,723	8,540	8,030	8,796	8,100
Distillate fuel oil	do.	54,530	49,800	51,976	46,500	50,000
Lubricants	do.	800	825 e/	850	850 e/	850
Residual fuel oil	do.	37,700	37,400 e/	36,646	37,960	36,800
Other e/	do.	2,700	3,000	3,500	3,500	3,500
Total	do.	159,441	154,685 r/	161,902 r/	157,254 r/ e/	158,750

e/ Estimated. r/ Revised.

1/ Table includes data available through August 1, 1998.

2/ In addition to the commodities listed, secondary aluminum, secondary lead, and secondary copper may be produced in small quantities, and crude materials are produced for local consumption. Output is not reported, and available information is inadequate to make estimates of production levels.

3/ Reported figure.

4/ Includes about 50,000 metric tons of plaster each year.

5/ Excludes gas used in reinjection, flaring, venting, transmission losses, and natural gas liquids extraction.

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TABLE 2
ALGERIA: EXPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Destinations: United States	Destinations: Other (principal)
METALS				
Aluminum, metal including alloys:				
Scrap		5,039	--	France 4,948; Spain 69; Italy 13.
Semimanufactures		307	--	France 305; Tunisia 1.
Cadmium, metal including alloys, all forms		35	--	All to the Netherlands.
Copper, metal including alloys:				
Scrap		9,337	--	France 9,070; Spain 124; Belgium-Luxembourg 81.
Unwrought		255	--	France 191; Belgium-Luxembourg 42; Switzerland 12.
Semimanufactures		75	--	All to France.
Iron and steel:				
Ore and concentrate, roasted pyrite		2,000	--	All to Tunisia.
Metal:				
Scrap		60,178	--	France 23,197; Italy 12,245; Switzerland 9,289.
Pig iron, cast iron, related materials		298,285	--	Italy 253,585; Spain 18,000; Egypt 14,700.
Steel, primary forms		17,607	--	Tunisia 7,657; Spain 5,650; Lebanon 4,300.
Semimanufactures:				
Flat-rolled products, of iron or nonalloy steel:				
Not clad, plated, coated		59,914	--	Italy 22,970; United Kingdom 11,200; Morocco 9,232.
Clad, plated, coated		1,537	--	All to Tunisia.
Bars, rods, angles, shapes, sections	value, thousands	$4	$4	
Wire		1	1	
Tubes, pipes, fittings		18,725	11	Netherlands 13,699; Belgium-Luxembourg 5,000; Saudi Arabia 7
Lead:				
Ore and concentrate		1,140	--	All to Bulgaria.
Metal including alloys:				
Scrap		1,362	--	All to France.
Unwrought		1,539	--	Italy 1,238; Tunisia 300.
Semimanufactures	value, thousands	$1	$1	
Magnesium, metal including alloys:				
Scrap		5	--	All to France.
Unwrought		6	--	All to Belgium-Luxembourg.
Mercury		245	--	Belgium-Luxembourg 105; Italy 69; United Kingdom 35.
Nickel, metal including alloys:				
Scrap		14	--	All to France.
Semimanufactures		20	--	Do.
Zinc, metal including alloys:				
Scrap		272	--	Do.
Unwrought		26,558	1,019	Netherlands 10,317; France 5,894; Italy 4,372.
Semimanufactures 2/		69	--	France 47; Italy 22.
Other, ashes and residues		5,917	--	Belgium-Luxembourg 5,359; France 345; Italy 200.
INDUSTRIAL MINERALS				
Abrasives, n.e.s., grinding and polishing wheels and stones	value, thousands	$1	--	All to Italy.
Cement		122	--	All to Mali.
Clays, crude:				
Bentonite		2,528	60	Tunisia 2,468.
Unspecified		1,830	--	Italy 1,430; Egypt 200; Tunisia 200.
Diatomite and other infusorial earth		1,123	--	Tunisia 760; Morocco 360; Spain 3.
Fertilizer materials, manufactured:				
Ammonia		129,821	11,000	Switzerland 42,001; Norway 24,700; Italy 17,609.
Nitrogenous		7,962	--	France 6,000; Spain 1,962.
Gypsum and plaster		20	--	All to Niger.
Phosphates, crude		444,826	--	Russia 172,746; Switzerland 108,206; Turkey 29,768.
Salt and brine		3,420	400	Guinea 3,020.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		86	--	All to Belgium-Luxembourg.
Worked		23	--	All to France.
Quartz and quartzite		1	--	Do.

See footnotes at end of table.

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TABLE 2--Continued
ALGERIA: EXPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Destinations	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS				
Sulfur, sulfuric acid		24,115	--	Portugal 11,179; Spain 10,675; Tunisia 2,058.
Gas, natural:				
Gaseous	thousands tons	18,269	--	Italy 16,770; Tunisia 1,178; Yugoslavia 321.
Liquefied	do.	15,071	664	France 5,586; Spain 3,703; Belgium-Luxembourg 2,777.
Petroleum:				
Crude	do.	33,934	6,471	Netherlands 4,151; Italy 4,005; Canada 3,725.
Refinery products:				
Liquefied petroleum gas	do.	3,864	795	Italy 842; Turkey 504; Spain 325.
Gasoline	do.	2,424	225	Netherlands 903; France 429; Spain 282.
Kerosene and jet fuel		129,055	--	United Kingdom 39,756; South Korea 26,338; Netherlands 21,01:
Distillate fuel oil	thousands tons	2,013	57	South Korea 495; Italy 350; France 288.
Lubricants		11,560	--	Greece 5,339; Ital 3,203; Indian2,962.
Residual fuel oil	thousands tons	3,296	2,483	Italy 669; Germany 64; United Kingdom 53.

1/ Table prepared by Glenn J. Wallace.
2/ Includes dust, flakes, and powders.

Source: United Nations Statistical Office (microfiche).

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TABLE 3
ALGERIA: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals		2	(2/)	Mainly from France.
Alkaline-earth metals		3	--	Mainly from United Arab Emirates.
Aluminum:				
Oxides and hydroxides		239	(2/)	Germany 200; Spain 18; France 14.
Metal including alloys:				
Unwrought		5,574	--	Egypt 2,837; Spain 2,266; Germany 460.
Semimanufactures		15,920	52	Tunisia 7,200; France 2,185; Italy 1,599.
Antimony, metal including alloys, all forms		100	--	Mainly from China.
Beryllium, metal including alloys, all forms	value, thousands	$1	--	All from France.
Chromium, oxides and hydroxides		44	--	Spain 42; China 2.
Cobalt, oxides and hydroxides		55	--	China 53; France 2.
Columbium and tantalum, ore and concentrate 3/		33	--	All from Spain.
Copper:				
Matte and speiss including cement copper	value, thousands	$4	--	All from France.
Metal including alloys:				
Unwrought		2,056	(2/)	Portugal 1,997; Switzerland 37; France 13.
Semimanufactures		11,832	4	Spain 4,463; Turkey 2,369; Italy 2,301.
Gold, metal including alloys, unwrought and partly wrought	kilograms	363	--	Switzerland 298; France 50.
Iron and steel, metal:				
Scrap		86	--	All from France.
Pig iron, cast iron, related materials		485	--	France 227; Germany 127; Sweden 70.
Ferroalloys:				
Ferrochromium		10	--	Mainly from Belgium-Luxembourg.
Ferromanganese		402	--	Sweden 188; France 150; Belgium-Luxembourg 43.
Ferronickel		1	--	All from France.
Ferrosilicomanganese		29	--	Sweden 11; Belgium-Luxembourg 10; Norway 8.
Ferrosilicon		170	--	France 101; Norway 49; Belgium-Luxembourg 20.
Silicon metal 4/		88	(2/)	France 88.
Unspecified		52	--	Germany 47; France 5.
Steel, primary forms		1,701	--	Italy 595; France 444; Germany 282.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		165,365	25	Spain 72,214; France 23,603; Belgium-Luxembourg 19,525.
Clad, plated, coated		22,893	10	Spain 11,895; Portugal 2,969; Turkey 2,961.
Of alloy steel		10,596	36	Spain 4,881; Germany 3,989; France 1,472.
Bars, rods, angles, shapes, sections		619,176	377	Turkey 332,297; Spain 102,201; Russia 46,007.
Rails and accessories		2,900	--	Austria 2,385; France 513; Germany 1.
Wire		17,875	1	Turkey 6,773; Libya 2,736; Italy 2,717.
Tubes, pipes, fittings		288,061	59,035	France 100,952; Spain 251,717; Turkey 22,914.
Lead:				
Oxides		928	--	Italy 831; Spain 85; France 12.
Metal including alloys:				
Unwrought		7,235	--	Bulgaria 6,540; Yugoslavia 680; France 15.
Semimanufactures		1	--	Mainly from France.
Magnesium, metal including alloys:				
Unwrought		20	--	China 15; France 5.
Semimanufactures		1	--	Mainly from France.
Manganese:				
Oxides and hydroxides		262	--	Brazil 260; France 2.
Metal including alloys, all forms	value, thousands	$6	--	All from France.
Mercury		1	--	Mainly from Spain.
Molybdenum, metal including alloys, semanufactures		4	2	Belgium-Luxembourg 2.
Nickel, metal including alloys:				
Unwrought		17	--	All from France.
Semimanufactures		18	(2/)	France 17; Belgium-Luxembourg 1.

See footnotes at end of table.

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TABLE 3--Continued
ALGERIA: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS--Continued				
Platinum-group metals, platinum metal including alloys, unwrought and partly wrought	value, thousands	$31	--	All from France.
Silver, metal including alloys, unwrought and partly wrought	do	$683	--	Germany $439; France $204; Italy $30.
Tin, metal including alloys:				
Unwrought		43	--	Malaysia 25; France 18; Germany 1.
Semimanufactures		52	3	China 39; France 5; Egypt 3.
Titanium:				
Ore and concentrate		370	--	India 270; Russia 100.
Oxides		7,680	--	Saudi Arabia 3,225; Spain 1,757; Russia 1,200.
Metal including alloys, semimanufactures		9	--	Mainly from Italy.
Tungsten, metal including alloys:				
Unwrought, including waste and scrap		2	--	All from China.
Semimanufactures		3	(2/)	Belgium-Luxembourg 1; France 1.
Zinc:				
Ore and concentrate		1,556	--	All from Peru.
Oxides		102	(2/)	Belgium-Luxembourg 53; France 40; Spain 8.
Metal including alloys, semimanufactures 5/		183	--	Belgium-Luxembourg 110; Italy 53; United Arab Emirates 20.
Zirconium, ore and concentrate		140	--	All from Italy.
Other:				
Ores and concentrates		5	--	All from Morocco.
Oxides and hydroxides		239	1	France 92; Belgium-Luxembourg 56; Germany 43.
Ashes and residues		347	302	Sweden 45.
Base metals including alloys, all forms		19	--	All from Germany.
Metalloids 6/	value, thousands	$3	--	France $2; Belgium-Luxembourg $1.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc.		96	--	Turkey 35; Greece 29; Italy 14.
Artificial corundum		427	223	Austria 201; France 3.
Grinding and polishing wheels and stones		1,361	1	Italy 841; Czech Republic 173; France 158.
Asbestos, crude		7,102	--	Canada 6,900; Zimbabwe 202.
Barite and witherite		11,544	2,354	Spain 4,802; Turkey 4,002; United Kingdom 384.
Boron:				
Crude natural borates		25	--	All from Belgium-Luxembourg.
Oxides and acids		75	--	Turkey 65; France 9; Germany 1.
Bromine, fluorine, iodine	value, thousands	$9	--	Belgium-Luxembourg $6; France $2.
Cement	thousands tons	1,492	(2/)	Spain 754; Tunisia 462; Greece 120.
Chalk		11,393	--	Jordan 4,750; France 4,249; Spain 2,392.
Clays, crude:				
Bentonite		636	412	United Kingdom 179; Tunisia 44; Egypt 1.
Kaolin		6,073	--	United Kingdom 5,100; Germany 800; Spain 173.
Unspecified		7,417	47	United Kingdom 7,230; Spain 120; Tunisia 20.
Diamond, natural:				
Gem, not set or strung	value, thousands	$34	--	Belgium-Luxembourg $21; Democratic Republic of Congo $13.
Industrial stones	do.	$1	--	All from Germany.
Diatomite and other infusorial earth		24	--	Tunisia 20; Germany 4.
Feldspar		3,680	--	Turkey 3,279; Spain 401.
Fertilizer materials:				
Crude, n.e.s.		7	--	All from France.
Manufactured:				
Ammonia		7	(2/)	Germany 3; United Kingdom 2.
Nitrogenous		26,943	(2/)	Bulgaria 10,422; France 5,504; Spain 4,032.
Phosphatic		36,690	--	Morocco 8,600; Tunisia 6,500; France 4,500.
Potassic		12,384	457	Spain 7,805; Ukraine 2,700; Romania 923.
Unspecified and mixed		38,354	--	France 13,653; Romania 12,500; Greece 7,600.
Fluorspar		250	--	Sweden 105; Germany 55; Belgium-Luxembourg 50.
Graphite, natural		279	--	Spain 205; Germany 44; China 30.
Gypsum and plaster		233	16	France 166; Italy 35; United Kingdom 9.
Lime		798	400	Tunisia 315; Netherlands 50; Belgium-Luxembourg 25.

See footnotes at end of table.

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TABLE 3--Continued
ALGERIA: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
INDUSTRIAL MINERALS--Continued				
Magnesium compounds:				
Magnesite, crude		151	--	Italy 63; Austria 52; Spain 23.
Oxides and hydroxides		35	--	France 32; Italy 2; Japan 1.
Mica:				
Crude including splittings and waste		110	1	Canada 90; France 11; United Kingdom 8.
Worked including agglomerated splittings		12	(2/)	Japan 10; Italy 1.
Nitrates, crude		1	(2/)	France 1.
Phosphates, crude	value, thousands	$5	--	All from China.
Pigments, mineral, iron oxides and hydroxides, processed		395	(2/)	China 164; Italy 121; France 61.
Precious and semiprecious stones other than diamond:				
Natural	value, thousands	$5	--	All from France.
S ynthetic	do.	$17	--	All from Ireland.
Pyrite, unroasted		7	--	All from Denmark.
Salt and brine		550	23	Germany 251; France 156; Netherlands 106.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		12,285	3,002	Bulgaria 5,266; Spain 1,500; Germany 1,407.
Sulfate, manufactured		23,673	(2/)	Spain 23,523; Tunisia 100; Belgium-Luxembourg 35.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		3,078	--	Mainly from Italy.
Worked		245	--	Italy 155; China 42; Spain 21.
Dolomite, chiefly refractory-grade		380	--	France 351; Austria 14; Spain 12.
Gravel and crushed rock		3,304	115	Italy 3,057; France 127; Denmark 5.
Quartz and quartzite		25	--	Spain 20; France 5.
Sand other than metal-bearing		262	149	United Kingdom 42; Denmark 37; Turkey 18.
Sulfur:				
Elemental:				
Crude including native and byproduct		652	--	All from Spain.
Colloidal, precipitated, sublimed	value, thousands	$2	--	All from Belgium-Luxembourg.
Dioxide		20	--	All from France.
Sulfuric acid		363	1	Belgium-Luxembourg 351; France 10; Germany 1.
Talc, steatite, soapstone, pyrophyllite		777	--	France 751; Switzerland 10; Tunisia 9.
Vermiculite, perlite, chlorite		12	--	Italy 11; France 1.
Other:				
Crude		949	(2/)	Belgium-Luxembourg 603; China 102; France 83.
Slag and dross, not metal-bearing		26	--	All from United Kingdom.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		129	125	Italy 3; France 1.
Carbon black		272	--	France 180; Germany 87; Spain 2.
Coal:				
Anthracite		304	--	All from United Kin dom.
Lignite including briquets		11	11	
Unspecified		317,793	160,165	Australia 157,628.
Coke and semicoke		89,100	--	All from Japan.
Gas, natural, liquefied		10	10	
Peat including briquets and litter		575	--	Belgium-Luxembourg 410; Germany 138; France 27.
Petroleum:				
Crude		68,590	--	Mainly from Brazil.
Refinery products:				
Liquefied petroleum gas	value, thousands	$17	$5	Switzerland $6; France $5; United Kingdom $1.
Gasoline		1,585	136	United Arab Emirates 1,099; Italy 95; Spain 91.
Mineral jelly and wax		3,459	--	Spain 1,667; France 1,601; Belgium-Luxembourg 110.

See footnotes at end of table.

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TABLE 3--Continued
ALGERIA: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS--Continued				
Petroleum--Continued:				
Refinery products--Continued:				
Distillate fuel oil	value, thousands	$1	--	All from France.
Lubricants		138,718	77	Syria 103,247; France 20,266; Netherlands 7,829.
Residual fuel oil		168,791	(2/)	France 59,941; Italy 46,850; Greece 25,000.
Bitumen and other residues		11,839	--	Spain 11,574; Tunisia 225; France 40.
Bituminous mixtures		4,447	19	France 2,989; Spain 792; Austria 500.

1/ Table prepared by Glenn J. Wallace.
2/ Less than 1/2 unit.
3/ May include vanadium.
4/ May include high-purity silicon.
5/ Includes dust, flakes, and powders.
6/ Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

Source: United Nations Statistical Office (microfiche).

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THE MINERAL INDUSTRY OF

ANGOLA

By George J. Coakley

Angola had a population of about 10.5 million in a 1,246,700-square-kilometer (km^2) area, which includes Cabinda, a 100-kilometer (km)-wide and 150-km-deep coastal strip located between the Republic of the Congo [Congo (Brazzaville)] and the Democratic Republic of the Congo [Congo (Kinshasa)]. Cabinda is the source of about 50% of Angola's oil production. In 1997 the mineral economy of Angola was dominated by petroleum. The $4.7 billion in petroleum exports accounted for 90% of all exports and for more than 80% of government revenues. Angola's gross domestic product (GDP) was $8.31 billion by yearend 1996, with petroleum and related services accounting for about 50% of GDP. The economy still suffered from an hyperinflation of 1,500% per year. Following more than 20 years of fighting, the country's lengthy civil war appeared to be resolved with the signing of the Lusaka Peace Protocol in 1994. During 1997, substantial progress was made in forming a new coalition government, the Government of Unity and National Reconciliation (GURN), in April and in the demilitarization of National Union for the Total Independence of Angola (UNITA) opposition forces and the withdrawal of UNITA forces from areas, especially diamond mining areas, occupied during the war. GURN began to rebuild a shattered economy and to attract foreign investment back to the minerals sector. Major successes in petroleum exploration and in diamond exploration and mine permitting in 1997 held considerable promise for the future of mineral development in Angola.

Mining and petroleum development are governed by several legal statutes, most of which have been updated within the past 5 years. They include Foreign Investment Law No. 15/94 of October 23, 1994, which empowered the Foreign Investment Center to reject or approve new investment applications within 45 to 90 days on investments up to $50 million. Investments of more than $50 million must be evaluated and forwarded to a Ministry of Planning and Economic Coordination within 40 days and a Negotiating Commission established within another 15 days. The Law on Geological and Mining Activities (Mining Law) No. 1/92 of January 17, 1992, administered by the Ministry of Geology and Mines, established the legal framework for prospecting, mining, processing, marketing, suspension or exhaustion, and reclamation of mineral resources, including stockpiles and waste heaps from old mining. Mineral rights were vested in the State. The law eliminated the State monopoly on mineral rights and provided for granting prospecting licences and mining titles to either State owned, mixed, private, or joint mining companies. As of mid-1997, 44 prospecting licences and 138 mining titles had been granted under the 1992 Mining Law. A separate Law on Diamonds was promulgated as law No.15/94 on January 7, 1994, and granted exclusive mineral rights for diamonds to the state-owned diamond mining company, Empressa Nacional de Diamantes de Angola (Endiama).

The laws on privatization were established under law No. 10/94 of 1994. Under decree No. 4-B/96 of May 31, 1996, which established the Rules for Taxation for the Mining Industry, domestic and foreign investors are treated equally. Corporate taxation was set at 40% of the net profit. Royalty rates were set at 5% on precious stones and metals, 4% on semiprecious stones, 3% on metallic minerals, and 2% on other minerals. A surface tax of from $1.00 to $4.00 per square kilometer held is paid during exploration. Depreciation of fixed assets was allowed and exploration costs can be written off during the first 3 years of the mining stage (Sumbula, 1998). Petroleum exploration and development were administered under the Hydrocarbon Law of 1978, which made Sociedade Nacional de Combustiveis de Angola (Sonangol) the sole concessionaire for exploration and production. International oil companies operated in joint ventures or under production-sharing agreements with Sonangol.

In 1997, Angola exported nearly 263 million barrels (Mbbl) of crude oil, of which 55% went to the United States. As part of a debt-servicing agreement, Angola exported nearly 7.3 Mbbl per year to Brazil. Angolan crude also was exported to European and Asian markets

Production of oil and gas continued on an upward trend, as did cement, a leading indicator of a rebuilding economic infrastructure. The apparent decline of diamond production was attributed to the withdrawal of UNITA forces from the active diamond fields in the northwestern provinces. Recent desegregated trade data were unavailable.

Among the metal commodities, exploration was most active for gold. Ashanti Gold Fields Co. Ltd. of Ghana held the 740-square-kilometer (km^2) Bentiabo concession in Huila Province, with exploration ongoing in 1997. In July 1997, Anmercosa Exploration, a subsidiary of the Anglo American Corp. of South Africa, was awarded two concessions in southern Angola, near the border with Namibia. Anmercosa planned a 3-year, $1 million exploration program to examine the area for nickel, copper, zinc, and gold potential.

A consortium of Kobe Steel and Nissho Iwai of Japan and Odebrecht Mining Services Inc. of Brazil was exploring the feasibility of building a Midrex, direct-reduced iron plant in Angola using domestic iron ore resources. Initial interest in reopening the Kassinga iron ore mine in the southern part of the country had switched to determining the feasibility of developing the 1-billion-metric-ton Kassal-Kitunga titaniferous magnetite deposit, which had a more-favorable location and transport infrastructure. The Government also transferred the iron ore mining rights from the old State-owned company, Companhia de Ferro de Angola (Ferrangol), to a newly constituted Kassinga Mining Joint Company, which was to look at the potential for reopening Kassinga. Kassinga had remaining drilled resources of 100 million metric tons (Mt) of iron ore, principally hematite containing 30% to 34% iron (Metal Bulletin, 1997).

In February, Easton Minerals Ltd. of Canada was granted a

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20,000-km^2 Prospecting License in the Cunene anorthosite complex centered around the city of Lubango in Huila Province. Easton acquired a 70% interest in the property from Cornerstone Diamond Corp. Ltd., which retained a 30% carried interest. Exploration priorities will be gold, nickel, copper, cobalt, vanadium, chromium, and platinum (Easton Minerals Ltd., 1997).

The diamond areas, which were previously controlled by UNITA, in Lunda Norte and Lunda Sul Provinces and accounted for about $400 million out of Angola's annual national diamond output of $1.1 billion, were opened to outside exploration and development companies in 1996, although some concession areas were still waiting for the full withdrawal of UNITA armed forces in 1997. Endiama issued exploration licenses or entered into joint ventures for a number of projects.

Production began in May 1997 at Angola's first kimberlite mine at Catoca, in Lunda Sol Province. The $24 million project was capitalized by Sociedade Miniera de Catoca Ltda., a joint venture comprising Endiama (40%), Russia's Almay Rossii-Sakha (40%), and Brazil's Odebrecht Mining Services Inc. (20%). Production from the Catoca pipe, which had the fourth largest surface area of any known kimberlite, will begin at a rate of 250,000 carats per year in 1997-98, increase to 550,000 carats per year in 1998-99, 850,000 carats per year in 1999-2000, and 990,000 carats per year between 2000 and 2007. Mine production is expected to have an average value of $75 to $100 per carat, with output consisting of 35% gem quality, 15% near gem quality, and 50% industrial diamonds (Diamond International, 1997).

Sociedade de Desenvolvimento Mineiro de Angola, S.A.R.L. (SDM), a joint venture between Ashton Mining Ltd. of Australia, Endiama, and Odebrecht was formed in 1995 to mine alluvial diamonds in the 85,600-km^2 Cuango River Valley concession, centered near the town of Luzamba in northeastern Angola. Ashton reported the Cuango diamonds to be of high quality with an average value in the range of $200 to $350 per carat (Ashton Mining Ltd. of Australia, 1998, Annual report, accessed June 1, 1998, at URL http://www.ashton.net.au/report/index.html). SDM agreed to develop the project only after UNITA-controlled diamond areas were transferred to the Angolan Government in January 1998. Mining was expected to begin in the second half of 1998 following the rehabilitation or replacement of the existing plant and equipment. Initial project funding will be $50 million. In a separate project, Ashton entered a 50-50 joint venture with the Angolan company Bapsil Service Ltda. to explore a 10,000-km^2 diamond concession in the Luange River area adjacent to the SDM Cuango concession.

In 1996, the Canadian company, Carson Gold Corporation, and its subsidiary, Branch Energy Ltd., acquired majority interest in reported resources of more than 10 million carats of diamond in the Luo and the Luarica concessions in Lunda Norte Province. Carson Gold was subsequently renamed DiamondWorks Ltd. of Canada in 1997 (DiamondWorks Ltd., June 27, 1996, Carson to become world player in diamond industry—Carson acquires major diamond concession in Africa, accessed June 3, 1997, at URL http://www.diamondworks.com/news.html). DiamondWorks began commercial production by using a floating dredge and processing alluvial gravels in a 50-metric-ton-per-hour dense-media separation plant at the Luo Mine in July 1997. The plant produced 28,590 carats from June through November 1997 with an average sales value of $238 per carat. Output included 36 stones, between 10 and 33 carats and 161 stones between 5 and 10 carats. Based on 1997 output, 1998 production is expected to exceed 80% gem quality with average values exceeding $300 per carat. The company also started to evaluate the Camatchia and the Camagico kimberlite pipes at Luo to determine the feasibility of an open pit mining operation capable of producing an additional 250,00 to 500,00 carats per year. DiamondWorks also began development work on a second property, the 550-km^2 Yetwene concession on the Chicapa and the Lumanha Rivers, in Lunda Norte Province. DiamondWorks acquired a 50% interest in Yetwene in May 1997 by exercising agreements between DiamondWorks and the operator, Zizania Holdings Ltd. of the United Kingdom, along with a concurrent agreement between its subsidiary, Branch Energy, and two Angolan companies, Sociedade Mineira do Lucapa and Sociedade Mineira e de Investimentos da Lunda, S.A. Operations at the Yetwene Mine were planned to startup in the second quarter of 1998, with production expected to reach 8,000 carats per month of high quality diamonds with values similar to that at Luo (DiamondWorks Ltd., December 19, 1997, DiamondWorks diamond production surpasses 28,00 carats in fiscal 1997, accessed February 1, 1998, at URL http://www.diamondworks.com/s/Reports.asp?/NewsReleases=&rt=1&reportID=1052).

As part of the peace accord, UNITA formed a new legally recognized mining company, Sociedade Geral das Minas (SGM), in 1997. Endiama granted SGM rights to two nonproducing diamond concessions, a kimberlite area in Cuando-Cubango Province and an alluvial area in the central highlands near Andula. Negotiations were underway on possible SGM participation in the SDM project and in the Luarica concession in Lunda Norte. The resolution of SGM's legally recognized property rights was a key to the withdrawal of UNITA forces from diamond mining areas they have occupied, and derived substantial revenue from, since 1992 (Financial Times, 1997).

SouthernEra Resources Ltd. of Canada (reports accessible on the Internet at URL http://www.southernera.com) reached an agreement with Sphere Trading Ltd. in September 1996 to cooperate in exploration and development of 4 alluvial diamond concession areas, including the Luo concession. Sphere mined 48,000 carats averaging over $99 per carat from this area in 1996. For payment of $2.5 million SouthernEra obtained rights to 35% of profits from properties it operates and 10% of net profits from Sphere operations in return for technical expertise and financing. In 1997, SouthernEra mined approximately 22,000 carats of diamonds averaging over $350 per carat from riverbed and flood plain gravel operations on the Chicapa River at the Luo concession. In March 1997 the Angolan Council of Ministers granted SouthernEra a 51% interest in a 160-hectare concession covering the Camafuca-Camazambo kimberlite pipe in the Calonda area of Linda Norte Province. Camafuca is described as the world's largest undeveloped kimberlite pipe. Earlier exploration of the kimberlite ceased in 1982. An agreement called for buying out one of its partners, SAA Distributors (Pty) Ltd. with $5 million by April 1997 and $7 million by April 1998. They also agreed to spend $5 million on exploration within 5 years. Other partners include Endiama (20%), Socidade Miniera Do Lucapa, S.A.R.L. (SML), (15%), Consorcio Minera Camafuca Camazambo, S.A.R.L. (Comica), (7%) and SAA, (7%). SouthernEra began a large diameter drilling program to confirm earlier work on high grade areas and to collect a bulk sample for

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price evaluation. Further bulk sampling and installation of a test plant will be carried out in 1998.

De Beers Consolidated Mines Ltd. of South Africa (press releases accessible on the Internet at URL http://edata.co.za/debeers/), in mid-1996, after a 10-year absence from Angola, acquired the right to examine the alluvial and kimberlite diamond potential at Mavinga in Cuando-Cubango Province and at Quela in Malange Province and to explore for kimberlites in Lunda Norte and Lunda Sul Provinces. A 5-year, $50 million exploration program was planned. De Beers also contracted to build a $30 million diamond training and sorting facility in the capital city of Luanda.

Other diamond concession holders included American Mineral Fields, Inc. (AMF) of Canada (reports accessible on the Internet at URL http://www.am-min.com), which, in May 1996, acquired a 50% interest in diamond concessions held by a Dutch West Indies security firm, International Defense and Security Forces Resources N.V. (IDAS), on the Luremo River near the border with Congo-Kinshasa. IDAS held a 50% interest in two properties with Endiama (50%), a 3,700-km^2 mining lease in the Cuango Valley, Luremo, and a 36,000-km^2 prospecting lease called the Cuango International, which borders the mining lease to the north. In early January 1998, AMF entered an agreement to purchase 100% of IDAS for 2.25 million and a 30% net profit interest in production from the concessions up to a maximum of $84 million.

Botswana Diamondfields Inc, a subsidiary of the Crew Group of Canada (press releases accessible on the Internet at URL http://www.crewgroup.com/bwd/), entered a 5-year long joint venture agreement with Gema Dourada Ltd. (GDL) to explore a 13,230-km^2 concession in the most northern part of Lunda Norte province. A recent prefeasibility study in the area by GDL and Endiama established a possible 1-million-carat resource at grades in the range of 0.4 to 0.7 carat of diamond per cubic meter (Botswana Diamondfields Inc., 1997).

Endiama also entered a joint venture with Sociedade Portuguesa de Emprendimentos in Socidade Mineira de Lucapa's 8,000-km^2 concession in the Camfue and Camiambo areas of Lunda Norte.

Trans Hex International Ltd. of South Africa (press releases accessible on the Internet at URL http://www3.stockgroup.com/thi/) agreed to fund 75% of Longreach Gold Oil Ltd's (Australia) share of the exploration of the Diagema, Kupolu, and Somicoa diamond concessions, located on the Chicapa and Luachimo Rivers in the Lucapa area, in Lunda Norte Province. Longreach holds a 50% interest in the concessions. Trans Hex consultants reported an indicated and inferred resource on two of the concessions at 400,000 carats of gem quality diamond in the $200-per-carat range.

In the petroleum sector, the peace accord has led to renewed interest and investment in offshore petroleum exploration in the Angolan exclusive economic zone, particularly in the deep-water blocks. Between 1993 and 1997, an estimated $4 billion has been spent on petroleum exploration and production in Angola. Favorable exploration results from offshore drilling in 1996 and 1997 indicated considerable potential for significantly expanding Angola's petroleum production over current levels of about 720,000 barrels per day (bbl/d) of crude oil, with production expected to increase by 70% to 1,217,000 bbl/d by 2003 (Arab Oil and Gas, 1997). This expansion in production will make Angola the fourth largest producer in Africa, after Nigeria, Libya, and Algeria. Chevron of the United States and the French company Le Group Elf Aquitane (Elf) were the major petroleum operators. The Chevron subsidiary, Cabinda Gulf Oil Company (CABGOC), accounted for nearly 65% of crude production from fields located offshore Cabinda. Chevron spent $500 million on exploration, drilling, and production in 1996 and increased this amount to $700 million in 1997.

The U.S. Department of Energy, Energy Information Agency, maintains an "Energy Country Analysis Brief " covering recent developments in the Angolan oil industry (accessible on the Internet at URL http://www.eia.doe.gov/emeu/cabs/angola.html). Highlights from the May 1998 Energy Country Analysis Brief are summarized below. CABGOC is operated by Chevron which holds a 39.2% share in the joint venture with Sonangol (41%), Elf (10%) and Agip Petroli of Italy (9.8%). The largest producing fields are Takula (Area A), Numbi (Area A), and Kokongo (Area B). CABGOC and its partners hope to expand production in the three areas to 600,000 bbl/d by the turn of the century. CABGOC made a significant oil discovery, in deeper waters offshore Cabinda, in April 1997. The field, designated Kuito, has estimated recoverable reserves of 1 billion to 2 billion barrels. Kuito lies in waters 1,300 feet (400 meters) deep in Block 14, which is adjacent to Areas B and C. CABGOC is the operator of the production sharing agreement working on Block 14 and has a 31% interest in the venture. Other partners in the production-sharing agreement are Sonangol (20%), Total (20%), Agip (20%), and Petrogal (9%). Initial production from Kuito is expected to begin in 1999 at the rate of 50,000 bbl/d, eventually increasing to 200,000 bbl/d. CABGOC announced in January 1998 a second major oil find on Block 14. The Landana field tested at rates similar to the Kuito field, and CABGOC and its partners are planning to drill three additional exploratory wells on Block 14 to delineate the size of the discovery. If viable, Landana could be on-stream by the end of 1999.

Elf controls the second largest area of production in Angola in Block 3, which is located offshore of the northern coast. The largest fields on Block 3 are Pacassa, Cobo-Pambi, and Palanca. Elf has a 50% interest in Block 3. Other partners on the block include Sonangol, Agip, Svenska Petroleum, Nis Naftgas, Ina Naftaplin, and Ajoco. The Oombo field, a satellite of the Cobo-Pambi field (1996 production of 54,000 bbl/d), came on-stream in January 1998 producing 9,500 bbl/d. Elf has made several discoveries on Block 17, which is located in deep offshore waters northwest of Luanda. The Girassol field was discovered in 1996 in 1,365 meters of water. Girassol is estimated to contain between 700 million and 2 billion barrels of recoverable reserves. Development drilling on Girassol is scheduled to begin in September 1999, and production is planned to begin in the fourth quarter of 2000. Elf announced a second discovery on Block 17 in August 1997. The field, designated Dalia, has estimated recoverable reserves of 750 million to 1.5 billion barrels of oil. A second exploratory well was drilled on Dalia in December 1997, producing results similar to the initial find. Elf (35%) is partnering on Block 17 with, Esso Exploration Angola Ltd. (Exxon) of the United States (20%), BP Exploration (Angola) Ltd. of the United Kingdom (16.7%), Den Norske Stats Oljeseskap a.s (Statoil) of Norway (13.3%), Norsk Hydro ASA of Norway (10%), and Petrofina Exploration MBV (Fina) of Belgium (5%). Elf could have a combined production from the Girassol and the Dalia fields of over 500,000 bbl/d by 2002 (Reuters, 1997).

Block 2, located offshore of the northern Angolan city of Soyo,

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is also currently in production. Texaco and Total (France) are both operators on Block 2. Major fields include Lombo, Sulele, and Tubarao. Texaco was producing 110,000 bbl/d from the shallow water Block 2-80/85 and was actively exploring the deep water Block 22. Fina is the operator of Angola's onshore production. Production is centered in two areas, Kwanza near Luanda, and the Congo basin near Soyo. Production facilities near Soyo were damaged during the civil war, and a $250 million postwar rehabilitation program is underway. Ganda, Pangala, Kitona, and N'Zombo are the major onshore fields.

Exxon (40%), in partnership with BP (26.7%), Agip (20%), and Statoil (13.3%), was actively drilling the Kissanje and the Marimba sectors of Block 15 during 1997.

Ranger Oil of Canada is planning to drill additional wells near a 1996 discovery that tested at 7,400 bbl/d. Ranger has a 40% interest on the block, except for the Block 4-Kiame field where it has 100% interest. Production of 7,000 bbl/d on Kiame is scheduled to begin in 1998 at a development cost of $27 million. Ranger reported reserves of 8 Mbbl of crude in about 142 meters of water. The recent offshore discoveries in Angola have sparked interest in Angola's unclaimed blocks. Block 19, located in deep water offshore Luanda, was awarded to a group comprising Fina (30% and operator), Ranger (25%), Sonangol (20%), United Meridian Corp. of the U.S. (20%), and the Israeli firm Naptha (5%). Texaco was named operator of Block 22, and the Australian firm BHP was named operator of Block 21 in June 1997. Bids for Blocks 23, 24 and 25 were accepted in 1997, with the possibility of licenses being awarded in the first half of 1998. License awards for Blocks 31 to 34 may be granted by the end of 1998.

The Fina Petroleos De Angola refinery in Luanda has a current capacity of 32,100 bbl/d. The refinery is a joint venture among Sonangol (36%), Fina (61% and operator), and private investors (3%). Angola and China signed a letter of intent in January 1998 on joint construction of a second refinery at Lobito. A $1 billion, 200,000-bbl/d facility was planned. Angola was also in discussion with Mobil Corp. of the United States about the possibility of relocating a 100,000-bbl/d-capacity oil refinery from Wort, Germany, to Lobito (Wall Street Journal, 1997).

Proven reserves of petroleum at yearend 1997 were reported at 5.4 billion barrels and natural gas reserves at 48.1 billion cubic meters (see http://www.eia.doe.gov/emeu/cabs/angola.html). Overall diamond reserves have been estimated at 180 million carats (see http://www.angola.org/fastfacts/economic.html).

Angola's infrastructure suffered major deterioration during the civil war, either through direct military action or from lack of maintenance. The removal of land mines from strategic transportation routes remains a major priority, before rebuilding can be done. In 1997, the Government made an agreement with the Italian company Tor di Valle to restore the 1,350-kilometer-long Benguela Railroad from the port city of Lobito to the border near the Copperbelt of Congo (Kinshasa). The Benguela line was historically the major and economically most efficient route for copper, cobalt, and manganese exports from the Copperbelt. Tor di Valle has agreed to spend up to $500 million to renovate the line in return for rights to harvest and export 37,000 hectares of eucalyptus plantations along the rail line (Fleming, 1997). Odebrecht is also contracted to construct the 329-megawatt power plant at the Capanda Hydroelectric project.

Although off shore petroleum development and exports will dominate the economy of Angola for years to come and provide a major impetus to rebuilding the war torn economy and infrastructure, mineral development, especially of diamond, will play a significant secondary role and will stimulate further economic growth on the local and regional level. Geological environments in Angola known to be favorable to economic mineralization have been off limits to exploration during the prolonged civil war. The return of mining investment and the application of modern exploration concepts and technology hold promise for additional mineral discovery opportunities in Angola. The attraction of needed new mineral investment, however, will be contingent on the continued stabilization of the political environment and the successful completion of postwar efforts, such as the clearance of land mines from principal transportation routes and mining areas.

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TABLE 1
ANGOLA: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity		1993	1994	1995 e/	1996 e/	1997 e/
Cement, hydraulic e/	thousand metric tons	250	250	250	270	301 2/
Diamond 3/ 4/	thousand carats	1,000	1,400	2,900	2,500 2/	1,234 2/
Gas, natural: e/						
Gross 5/	million cubic meters	5,600	5,600	5,210 2/	19,800 r/	20,000
Dry	do.	560	560	560	2,000 r/	2,000
Granite	thousand cubic meters	1,130	1,490 e/	1,500	1,500	1,500
Marble	do.	104	91	100	100	100
Petroleum:						
Crude	thousand 42-gallon barrels	182,865	196,370	232,800 2/	259,150 2/	262,800 2/
Refinery products e/ 6/	do.	9,000	9,000	10,585 2/	11,000	11,700
Salt	metric tons	40,000 r/	40,000 r/	40,000 r/	40,000	40,000

e/ Estimated. r/ Revised.
1/ Includes data available through May 1998.
2/ Reported figure.
3/ Did not include smuggled production.
4/ Production was approximately 90% gem and 10% industrial grade.
5/ Angola has no natural gas distribution system. Most gas was vented and flared.
6/ Included asphalt and bitumen.

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THE MINERAL INDUSTRY OF

BENIN

By Philip M. Mobbs

The production of mineral commodities, primarily cement and crude petroleum, represented a minor part of the economy of Benin. *(See table 1.)* Mineral-resource development opportunities identified by the Office Béninoise des Mines (OBEMINES) included deposits of brick and china clay, feldspar, gold, the Loumbou-Loumbou iron-bearing deposit, marble, peat, the Mékrou phosphate deposit, silica sand, and a number of potential ornamental stone quarrying sites. OBEMINES also documented occurrences of columbium-tantalum, industrial diamond, gypsum, mica, rare earths, rutile, tungsten, and zircon in Benin (Ministry of Energy, Mining, and Hydraulics, 1992). For more extensive coverage of the mineral industry of Benin see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

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TABLE 1
BENIN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996 e/	1997 e/
Cement, hydraulic		506,196 r/	465,491 r/	578,827 r/	580,000 r/	550,000
Petroleum, crude	thousand 42-gallon barrels	1,062 r/	884	654 r/	1,000	1,100
Steel, crude e/		2,000 3/	--	--	--	--

e/ Estimated. r/ Revised.
1/ Includes data available through August 12, 1998.
2/ In addition to the commodities listed, a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone) are produced; but information is inadequate to make reliable estimates of output.
3/ Plant closed in 1993.

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THE MINERAL INDUSTRY OF

BOTSWANA

By Philip M. Mobbs

Botswana's rapid economic growth, which began in the 1970's, continued into 1997. Much of this growth can be attributed to the country's successful program of mineral exploration and development. Botswana was Africa's largest and the world's third largest producer of diamond. The mineral industry provided about 80% of the value of national exports and about 50% of Government revenue and was the principal reason the country had a high per-capita gross domestic product (GDP) and a surplus in balance of payments. The mining sector, mostly on the strength of diamond, accounted for about 33% of the GDP. Nickel and copper also played significant, though smaller, roles in the national economy. Other minerals produced included agate, clay, coal, cobalt, gold, salt, sand, silver, soda ash, and stone.

Diamond mining was dominated by Debswana Diamond Co. (Pty.) Ltd., with a total mine output of 20.1 million carats valued at $1.8 billion[1] in 1997 (Ministry of Minerals, Energy, and Water Affairs, unpub. data, 1998). Although the Government was seeking to diversify the mineral industry, diamond remained the exploration target for nearly 60% of the prospecting licences. Much of Botswana's mineral resources remained unexplored, buried under the sands of the Kalahari Desert, which covers much of the country. Known mineral deposits in Botswana included asbestos, chromite, feldspar, graphite, gypsum, iron, kaolin, talc, and uranium. Botswana also had large proven resources of bituminous coal.

The Government encouraged foreign investment in Botswana. There were no restrictions on reinvestment or repatriation of earnings and capital. The Ministry of Minerals, Energy, and Water Affairs had responsibility for the mining sector. According to the Mines and Minerals Act (Chapter 66:01), the Ministry granted reconnaissance permits (for 1-year general prospecting) and prospecting licenses (for 3 years plus two 2-year extensions with minerals and area specified). It negotiated 25-year mining leases with project plans, financial aspects, and lease extension conditions specified. Subunits of the Ministry also carried out geologic surveys, made mine safety and environmental inspections, and collected mineral-production information. The Ministry's Department of Mines maintained a register of mineral investment opportunities.

In 1996, the Government of Botswana began the legislative process to make investment in new mining developments more investor-friendly. A new Mine and Minerals Act was expected to go to Parliament in 1998. The new mining law would cover all mineral operations except diamond and petroleum.

The Government and Anglo American Corp. of South Africa Ltd. (AAC) were significant partners in Botswana's mineral industry. *(See table 2.)* De Beers Centenary AG, an AAC-affiliated company, owned one-half of Debswana. AAC had an equity interest in Botswana RST Ltd., which was the Government's partner in BCL Ltd., the nickel-copper-cobalt producer. AAC holdings also included substantial interests in Tati Nickel Mining Co. (Proprietary) Ltd. and Morupule Colliery (Proprietary) Ltd. Besides BCL, Debswana, and Botswana Ash (Proprietary) Ltd. (Botash) operations, the Botswana mining industry consisted of a number of medium- and small-scale mines producing agate, aggregates, bricks, clay, gold, and dimension stone.

Employment in the domestic mining industry was about 13,000 employees, slightly more than 5% of a total formal (wage-earning) employment of about 240,000. An additional 12,000 Botswana miners were employed in mines in South Africa. This was down from 13,000 in early 1996. Major mines, such as the BCL and the Botash operations, were situated in remote regions with few job opportunities. This, coupled with the state's ownership interest in the companies, resulted in the Government's active support of the operations.

BCL, employing about 44% of Botswana's mining sector workers, operated nickel-copper-cobalt mines and a smelter at Selebi-Phikwe, about 350 kilometers northeast of the capital of Gaborone. In addition to treating its own ore, BCL toll-smelted concentrate and ore for Tati Nickel. Total smelter output of about 50,000 metric tons per year of nickel-copper matte was shipped to Norway and Zimbabwe for refining. BCL and Tati Nickel were adversely affected by declining international metal prices.

In the metals sector, Fancamp Resources Ltd. of Canada and Freewest Resources Canada Inc. were prospecting on their joint venture licences, including the Craton Margin copper-gold prospect. Exploration operations in northern Botswana on the Bushman copper-silver project of Channel Islands-registered Mortbury Ltd., the Ngwako Pan copper-silver prospect of Astra Exploration and Mining (Proprietary) Ltd., and the Thakadu/Makala copper prospect of European Mining Finance Ltd. of Bermuda were not reported. Exploration drilling around the Phoenix Mine by Tati Nickel confirmed the presence of additional copper and nickel reserves. Tati Nickel also was exploring a geophysical anomaly near the Selkirk Mine. The Selkirk nickel-copper ore body was projected to be mined out by 2001 (LionOre Mining International Ltd., 1998, 1997 annual report, accessed August 28, 1998, at URL http://www.sedar.com/dynamic_pages/assoc_docs_e/d00000389.htm).

The decline of gold prices in 1997 significantly reduced the attractiveness of economically marginal gold operations. Monarch Goldfields Botswana (Proprietary) Ltd., a subsidiary of Gallery Resources NL of Australia, ceased mining at the Golden Eagle gold mine near Francistown. A Gallery subsidiary continued exploration on the Shashe concession. Trillion Botswana (Proprietary) Ltd., a subsidiary of Trillion Resources Ltd. of Canada, was exploring on the Marulamabedi gold prospect. Trillion and Lion Mining Finance Ltd. of the United Kingdom

[1]Where necessary, values have been converted from Botswana Pula (P) to U.S. dollars at the average rate of P3.63=US$1.00 for 1997.

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were prospecting on the Kalahari gold prospect. Bushman Resources Inc. of Canada held an option to earn interest in the Kalahari joint venture during 1997.

Reunion Mining Botswana Ltd., a subsidiary of Reunion Mining plc of the United Kingdom, and First Quantum Minerals Ltd. of Canada were exploring on their Kraaipan gold project. First Quantum ceased to fund the operation after it earned 20% interest in the project. At yearend, the Kraaipan joint venture partners were negotiating a farmout with Ashanti Goldfields Co. Ltd. of Ghana.

Debswana recovered diamond from the Jwaneng, the Letlhakane, and the Orapa Mines. Production was sold to the Central Selling Organisation of the United Kingdom, a De Beers subsidiary. Output from the Jwaneng Mine was 12.5 million carats in 1997 compared with 11.2 million carats in 1996. The Letlhakane Mine produced 893,500 carats in 1997 compared with 897,000 carats produced in 1996, and the Orapa Mine produced 6.7 million carats in 1997 compared with 5.6 million carats in 1996. Part of the production increase was attributed to Debswana's change from a 6-day-per-week to a 7-day-per-week operation. In March 1997, Debswana began the $440 million (1.6 billion pula) Orapa Mine expansion project (African Mining, 1997). Debswana proposed to double the production capacity of the Orapa Mine from about 6 million carats per year to 12 million carats per year by 2000.

Tswapong Mining Co. (Proprietary) Ltd., a venture of De Beers Prospecting Botswana (Proprietary) Ltd. (85%) and the Government of Botswana (15%), began a small-scale open pit operation at Martin's Drift, near Sesuleta. Economic diamond output from the five kimberlite pipes at Botswana's fourth diamond mine was expected to last for 4 years.

A number of international mining companies were exploring for diamond. AfriOre (Botswana) (Proprietary) Ltd., a subsidiary of AfriOre (Mauritius) Ltd., and Billiton plc, a subsidiary of Gencor Ltd. of South Africa through July 1997 and a public limited company registered in the United Kingdom for the remainder of the year, were exploring a number of properties in Botswana, including the Jwaneng East, the Kang West, the Khutse, the Kokong West, and the Orapa South exploration areas. During 1997, BHP Minerals International Exploration Inc. terminated its option on AfriOre's Gope area diamond joint venture. AfriOre divested itself of the Kang prospect, and De Beers Prospecting Botswana (Proprietary) Ltd. acquired the right to earn 60% in the Jwaneng East and the Orapa South diamond properties as the exploration manager for the joint ventures.

Auridiam Botswana (Proprietary) Ltd. (77.5%), a subsidiary of Auridiam Consolidated NL of Australia; Livre Holdings (Proprietary) Ltd., a subsidiary of Diamond Ventures NL of Australia (20%); and No Matata Diamonds Inc. (2.5%) were exploring on the Mmashoro and the Taukome diamond properties. Livre was earning a 51% interest in the properties. M.I.T. Ventures Corp. of Canada was earning 57.5% interest in the Auridiam and No Matata's Orapa licence. Botswana Diamondfields Inc. of Canada was prospecting on the Deception Pan, the Jwaneng, the Mopipi, and the Tswapong area licences.

Debswana and Falconbridge Ltd. of Canada were evaluating the Gope-25 exploration prospect. Fancamp Resources and Freewest Resources were evaluating their Gemsbok South diamond prospect. Redaurum Ltd. of Canada was exploring on the Orapa North diamond exploration lease. Redaurum relinquished two prospecting licences during 1997.

Reunion acquired two exploration licences in the Tsodilo area in April. Ashton Mining Ltd. of Australia subsequently acquired the option to earn 50% interest in the Ngami prospect (formerly the Tsodilo diamond prospect) from Reunion. Southern Africa Minerals Corp. of Canada was exploring its Molopo, Kokong, Mosomane, and Mabuesehube diamond licences. Trillion Resources Ltd. of Canada was prospecting for diamond on the Mmadinare lease. Trillion also was exploring on the Shashi diamond licence with Skeena Resources Ltd. and Nickelodeon Minerals Inc., both of Canada, and on the Sowa Pan diamond licence with Winspear Resources Ltd. of Canada. Consolidated Venturex Holdings Ltd. of Canada withdrew from the Sowa Pan joint venture during 1997. TNK Resources Inc. of Canada was exploring its Gope area licence.

Botash recovered from the 1996 floods. Soda ash output nearly rebounded to the record 1995 production levels. Botash, however, continued to operate at less than the soda ash plant's 300,000-ton-per-year capacity because of lower-than-projected demand from South Africa.

Transportation facilities were good on the eastern fringe of the country. Highways connected landlocked Botswana with Namibia, South Africa, and Zimbabwe. A single-track railroad, operated by Botswana Railways, runs from north to south through the eastern part of the country, connecting the South African and the Zimbabwean rail systems.

Asia had accounted for a significant proportion of international diamond sales. The Asian economic crisis that began in Thailand in midyear and spread through Southeast Asia had almost halved the demand from the region (Agencie France-Presse, June 29, 1998, Botswana stockpiles diamonds in face of weak market, accessed August 21, 1998, at URL http://www.afp.com/go/english/countries/page.phtml?id=botswana/light/980629190528.qd8pyuw6&name=Botswana). A prolonged crisis would adversely affect the market for Botswana's gems. Robust diamond and other mineral exploration activities, however, were expected to continue in the short term. The country's favorable geologic environment, mineral investment climate, political stability, and low tax rates should make Botswana a target for foreign mineral investment.

Botswana's long-term economic prospects must be viewed in context of the southern African region. Although Botswana's economy grew at an annual rate of over 10% in the 1980's, even as South Africa's politically isolated economy suffered, Botswana's economic fate is closely intertwined with that of its larger neighbor. Apart from minerals, Botswana's "engines of growth"—manufacturing and assembly for regional export, tourism, and offshore financing—are all contingent on the health of the South African economy and trade relations with regional nations.

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TABLE 1
BOTSWANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Coal, bituminous		890,000	900,298	898,383	763,240	776,920
Cobalt, smelter output, Co content of matte 3/ 4/		205	225	270	408 r/	348
Copper:						
Mine output, Cu content of ore milled		25,100	27,500 e/	24,700 e/	25,275 r/	22,840
Smelter output, Cu content of matte 3/ 4/		20,132	22,780	20,500	20,980 r/	18,350
Diamond 5/	thousand carats	14,730	15,550	16,802	17,388 r/	20,111
Gemstones, semiprecious 6/	kilograms	38,900 r/	67,000	20,000	35,000	54,000
Gold 7/	do.	192	234	86	5	28
Manganese ore (e/ 45% Mn) 8/		3,700	--	--	--	--
Nickel:						
Mine output, Ni content of ore milled		23,400	19,042	22,100 e/	21,910	19,860
Smelter output, matte, gross weight 3/		50,780	51,488	49,931	58,910 r/	50,570
Smelter output, Ni content of matte 4/		21,621	19,041	18,100	17,460 r/	14,990
Salt 9/		98,000	186,000	208,126	93,886	184,530
Sand, construction 10/	cubic meters	150,000	140,000	112,000	100,000 r/	100,000
Soda ash, natural		126,000	174,000	201,657	119,137	199,990
Stone, crushed	cubic meters	760,000	572,000	860,737	845,526	1,091,880

e/ Estimated. r/ Revised.

1/ Table includes data available through September 4, 1998.

2/ In addition to commodities listed, the following were produced, but information was inadequate to reliably estimate output: silver (estimated about 2% of reported gold bullion production) and clay for brick and tile (brick output reported was 20.7 million units for 1993, estimated to be equivalent to 41,000 metric tons of clay. Clay production for 1996 was reported as 198,500 metric tons.

3/ Smelter product was granulated nickel-copper-cobalt matte.

4/ Included some product from direct smelting ore; that is, ore not reported as milled.

5/ Assumed to contain about 70% gem and near gem.

6/ Presumably, principally agate. Reported as sales.

7/ Reported as bullion; historically included silver estimated to be about 2%.

8/ Production began in 1992 and ceased in November 1993.

9/ From natural soda ash production.

10/ Additional production of sand and gravel from small local operations was periodically reported, but information was inadequate to estimate output.

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TABLE 2
BOTSWANA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity	
Clay 1/		Lobatse Clay Works (Proprietary) Ltd. (Botswana Development Corp. and Interkiln Corp. joint venture)	Lobatse, 70 kilometers south-southwest of Gaborone	50,000	e/
Do.		Makoro Brick and Tile (Proprietary) Ltd.	Makoro, 10 kilometers south of Palapye	20,000	e/
Coal		Morupule Colliery (Proprietary) Ltd. (Anglo American Corp. of South Africa Ltd. (AAC) and related firms, 93.3%)	Morupule, 270 kilometers north-southwest of Gaborone	1,000,000	
Cobalt 2/		BCL Ltd., (Government, 15%; Botswana RST Ltd. (BRST), 85%)	Selebi-Phikwe, 350 kilometers northeast of Gaborone	500	
Copper 2/		BCL Ltd., (Government, 15%; BRST, 85%)	do.	26,000	
Copper ore		do.	Selebi-Phikwe, 350 kilometers northeast of Gaborone	1,800,000	
Do.		Tati Nickel Mining Co. (Proprietary) Ltd. (Lexan Trading Inc., 43%; Francistown Mining and Exploration Ltd., 42%; and Government, 15%)	Selkirk Mine, 23 kilometers east of Francistown and Phoenix Mine, near Francistown	1,560,000	3/
Diamond	thousand carats	Debswana Diamond Co. (Proprietary) Ltd. (Government, 50%; De Beers Centenary AG, 50%)	Jwaneng Mine, 115 kilometers west of Gaborone.	13,000	
			Orapa Mine, 375 kilometers north of Gaborone.	7,000	
			Letlhakane Mine, 350 kilometers north of Gaborone.	900	
Do.	do.	Tswapong Mining Co. (Proprietary) Ltd. (De Beers Prospecting Botswana Ltd., 85%, Government, 15%)	Tswapong Mine, 275 kilometers northeast of Gaborone.	3	e/ 4/
Gemstones, semiprecious	kilograms	Agate Botswana (Proprietary) Ltd.	Processing plant at Pilane, 45 kilometers north of Gaborone	60,000	
Do.	do.	Masa Precious Stones (Proprietary) Ltd.	Bobonong, east of Selebi-Phikwe	4,000	
Nickel 2/		BCL Ltd., (Government, 15%; BRST, 85%)	Selebi-Phikwe, 350 kilometers northeast of Gaborone	23,000	
Nickel ore		do.	Selebi-Phikwe, 350 kilometers northeast of Gaborone	1,800,000	
Do.		Tati Nickel Mining Co. (Pty.) Ltd. (Lexan Trading Inc., 43%; Francistown Mining and Exploration Ltd., 42%; and Government, 15%)	Phoenix Mine, near Francistown	1,500,000	5/
			Selkirk Mine, near Francistown	60,000	6/
Salt		Botswana Ash (Proprietary) Ltd. (Government, 50%; Anglo American Corp., 50%)	Sua Pan, 450 kilometers north of Gaborone	650,000	
Soda ash		do.	do.	300,000	

e/ Estimated.
1/ For brick and tiles.
2/ In nickel-copper-cobalt smelter matte.
3/ Copper content estimated at 1.5%.
4/ Production began in September 1997.
5/ Phoenix Mine ships about 100,000 tons of concentrate grading 5.5% nickel per year.
6/ Direct smelting ore grading an estimated 2.6% nickel.

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THE MINERAL INDUSTRY OF

BURKINA FASO

By Philip M. Mobbs

Burkina Faso's economy was dominated by agriculture, which accounted for about 40% of its gross domestic product (GDP). The minerals sector typically has accounted for only 1% to 2% of the GDP. There is international and local interest in developing the diamond, gold, limestone, manganese, phosphate, and zinc deposits of Burkina Faso. For more-extensive coverage of the mineral industry of Burkina Faso, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
BURKINA FASO: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Gold 3/	kilograms	5,000	4,000	3,000	4,000	1,450
Manganese, Mn content of ore		17	30	9	10	1
Pumice and related volcanic materials		10	11	11	11	10
Salt		7	7	7	7	5
Stone, marble		100	110	110	110	100

1/ Includes data available through August 12, 1998.
2/ In addition to the commodities listed, other industrial minerals and construction materials (phosphate, sand and gravel, etc.) are produced, but information is inadequate to make reliable estimates of output.
3/ Includes undocumented artisanal production.

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THE MINERAL INDUSTRY OF

BURUNDI

By George J. Coakley

The landlocked, 27,830-square-kilometer Central African nation of Burundi is located between Tanzania and the Democratic Republic of the Congo. In 1997, the population was 5.5 million, and the gross domestic product per capita, based on purchasing power parity, was estimated to be $660. The population was primarily dependent on subsistence agriculture. The civil unrest and violence of the mid-1990's were a disincentive to foreign investment. Historically, Burundi produced small quantities of gold, kaolin, and tin ore for export and limestone, peat, sand and gravel, and construction stone for domestic consumption. Recent production statistics are unavailable. The United Nations outlined a major nickel laterite deposit in the Musongati area in the late 1970's. Although the Musongati area has been looked at by several private companies since then, its remote location and long export transportation routes remain a constraint on development. Past surveys have identified a phosphate-bearing carbonatite deposit at Matongo and vanadium deposits at Mukanda. An investment brochure outlining Burundi mineral resources, prepared by the Ministry of Energy and Mines in April 1991, highlighted these and other minerals with development potential. The outlook for the minerals industry was for little change, pending resolution of the political situation. Hydropower potential and abundance of water were advantages. Long export transportation corridors and a poorly developed infrastructure were disadvantages. For more-extensive coverage of the minerals industry of Burundi, see the Other Countries of Africa chapter in the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

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THE MINERAL INDUSTRY OF

CAMEROON

By Philip M. Mobbs

Crude oil production continued to be of major economic importance to Cameroon, although production from existing oilfields has declined since 1994. *(See table 1.)* The most prolific crude-oil-producing regions were the offshore Rio del Rey Basin, northwest of Victoria, and the adjacent Lokélé concession, about 35 kilometers offshore. According to Oil & Gas Journal estimates cited by the U.S. Department of Energy, recoverable crude oil reserves in Cameroon's oilfields were about 400 million barrels (Energy Information Agency, January 29, 1998, Table 8.1 World crude oil and natural gas reserves, January 1, 1997, accessed September 8, 1998, at URL http://www.eia.doe.gov/emeu/iea/table81.html). Reserves of natural gas were estimated to be 100 billion cubic meters (Energy Information Agency, January 29, 1998, Table 8.1 World crude oil and natural gas reserves, January 1, 1997, accessed September 8, 1998, at URL http://www.eia.doe.gov/emeu/iea/table81.html). As reported by the Government, Cameroon hosted a variety of mineral occurrences, including bauxite, chromite, cobalt, copper, dimension stone, gemstones, gold, iron ore, lead, nickel, phosphate, salt, tin, titanium, and uranium (Ministry of Mines, Water, and Energy Resources, 1995). For more-extensive coverage of the mineral industry of Cameroon, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

Reference Cited

Ministry of Mines, Water, and Energy Resources, 1995, Mineral and energy potential of Cameroon: Yaoundé, Cameroon, Ministry of Mines, Water, and Energy Resources, 2 p.

TABLE 1
CAMEROON: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Aluminum metal, primary		86,500	88,836 r/	79,300	82,000 e/	82,000
Cement, hydraulic e/		620,000	620,000	620,000	600,000	600,000
Gold, mine output, Au content	kilograms	1,000 e/	800 r/	800 r/	1,000 e/	1,000
Petroleum:						
Crude	thousand 42-gallon barrels	42,705	47,140	39,400	33,945 r/	33,000
Refinery products e/	do.	8,400	8,000	9,000	9,200	9,200
Pozzolana e/		130,000	101,870 r/ 3/	100,000 r/	100,000	100,000
Stone: e/						
Limestone		57,000	57,000	57,000	50,000	50,000
Marble		200	200	200	200	200
Tin, ore and concentrate: e/						
Gross weight	kilograms	4,300	3,000	2,000	1,000	1,000
Sn content	do.	3,000	2,300	1,500	750	750

e/ Estimated. r/ Revised.

1/ Includes data available through August 12, 1998.

2/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, gravel, sand, and stone) presumably produced, but output is not reported, and available information is inadequate to make estimates of output levels.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

THE CENTRAL AFRICAN REPUBLIC

By Philip M. Mobbs

The Central African Republic's mining industry remained dominated by the production and export of alluvial diamond and gold. Other mineral occurrences reported in the Central African Republic by the Direction Générale des Ressources Minérales included clay, copper, iron ore, lignite, limestone, manganese, rutile, tin, and uranium (Ministère des Ressources Energétiques et Minérales, 1995). For more extensive coverage of the mineral industry of the Central African Republic, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

Reference Cited

Ministère des Ressources Energétiques et Minérales, 1995, The mineral sector of the Central African Republic—An introduction: Bangui, Central African Republic, Ministère des Ressources Energétiques et Minérales, 38 p.

TABLE 1
CENTRAL AFRICAN REPUBLIC: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Carats unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Diamond:						
Gem		369,923	400,940	400,000	350,000	380,000
Industrial		125,000	131,000	130,000	120,000	120,000
Total		494,923 3/	531,940 3/	530,000	470,000	500,000
Gold	kilograms	153 3/	138 3/	120	90	90

1/ Includes data available through August 12, 1998.
2/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, gravel, sand, and stone) presumably are produced, but output is not reported, and available information is inadequate to make estimates of output levels.
3/ Reported figure.

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THE MINERAL INDUSTRY OF

CONGO (BRAZZAVILLE)

By George J. Coakley

The Republic of Congo [Congo (Brazzaville)] is located in equatorial central Africa between the Democratic Republic of the Congo [Congo (Kinshasa)] and Gabon and has an area of 342,000 square kilometers. The area supported a population of about 2.9 million in 1997 with a gross domestic product (GDP) per capita of $2,000, based on 1996 purchasing power parity data.

The economy of Congo (Brazzaville) has been based largely on crude oil, which accounted for more than 40% of real GDP and more than 60% of foreign exchange earnings. The total value of exports, chiefly from crude oil, was $1.2 billion in 1995, the last year for which data was available. The Elf Aquitaine Group of France was the major operator in the petroleum sector and had a 65% share in total crude production. Most production was from offshore wells. Elf brought the major N'Kossa field into production in 1996, increasing output at N'Kossa to 73,000 barrels per day in 1997. Elf also announced plans to bring the Moho Marine 1 field into production by 2001. The Moho Marine 1 field, discovered in 1995, had reported reserves of more than 400 million barrels of oil. Italy's Azienda Generali Italiana Petroli S.p.A. (Agip), which operated through its subsidiary Agip Recherches Congo, accounted for much of the remaining 35% of oil production in Congo (Brazzaville). Chevron Corp. and Exxon Corp. of the United States, Naphta of Israel, and Energy Africa Ltd. of South Africa were also active. The U.S. Energy Information Agency reported total proven oil reserves of 1.5 billion barrels and natural gas reserves of about 90.6 billion cubic meters of natural gas reserves [U.S. Energy Information Agency, July 1998, Congo (Brazzaville) Country Analysis Brief, accessed February 12, 1999, at URL http://eia.doe.gov/emeu/cabs/congo.html].

Investment was governed by the Investment Code of 1992 and Hydrocarbon Law 24/94 of August 23, 1994, which dictates the terms of Production Sharing Agreements. The Hydrocarbon Law reduced taxes on crude oil production from 17.5% to 12%, with the state-owned Hydro-Congo participating in a 31% profit sharing on all production. Mining legislation is based on Law 29-62 of June 1962, as amended by Decree No. 23/82 of July 7, 1982, and Decree No. 86/814 of June 11, 1986. In general, mining has been carried out by the state or through state-owned joint ventures. Prior to the breakout of the civil war in 1997, a new mining code was presented to the National Assembly and Senate for consideration, but apparently was not acted on. The new code would have opened up mining to private investment (Ngot Kongolo, 1997).

The Ministry of Hydrocarbons and Mines stated that exploitable minerals in Congo included base metals (copper, lead, and zinc), diamond, gold, and platinum. Coastal deposits of phosphate and potash have yet to be exploited fully. Additionally, deposits of bentonite, granite, gypsum, kaolin, marble, and talc also were found in the country. In June 1997, the Government granted two exploration permits covering the Makola and the Youbi magnesium salt evaporite deposits in the Kouilou region to Congo Minerals, Inc., of Canada, which subsequently changed its name to Magnesium Alloy Corporation (MAC). The new Government ratified exploration and development agreements with MAC in January 1998. The deposits, which, according to MAC, contain 800 billion metric tons of indicated magnesium salt resources, could support a solution mining operation extracting 2.1 million metric tons per year of carnalite ore capable of producing 100,000 metric tons per year of magnesium metal along with byproduct potash, salt, calcium chloride, and chlorine (Magnesium Alloy Corporation, June 9, 1997, Republic of Congo, press release, accessed February 12, 1998, at URL http://magnesiumalloy.ca/press/970609.htm). During the year, several junior exploration companies were actively looking for gold or base metals—AfriOre Limited of Canada on the Yanga Koubanza lead-zinc deposit; SAMAX Gold Inc. of Australia on the Dimonika, Kakamoeka, and Ngongo districts within the Mayombe gold belt; SEMI on a gold property near Yangadou in Sangha province; and Panorama Resources NL of Australia for gold in within the Mayoko and the Zanaga greenstone belts in its Moussendjo concession.

Economic and political disruptions caused by the civil war in 1997 and the increased political risk associated with investing in Congo (Brazzaville) will likely delay or discourage new petroleum and mining development in the country, although the primarily offshore oil industry is somewhat sheltered from the extensive damage to onshore infrastructure inflicted during the war.

Reference Cited

Ngot Kongolo, J. C., 1997, Description sommaire du secteur minier Congolais: Multilateral Investment Guarantee Agency African Investment Symposium, 4th, June 3-5, 1997, Denver, Colorado, 6 p.

Major Source of Information

Ministere des Hydrocarbures et des Mines
Service des Mines et de la Geologie
B. P. 2124
Brazzaville, Republic of Congo
Telephone: (242) 83 58 73; Fax: (242) 83 62 43

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TABLE 1
CONGO (BRAZZAVILLE): PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1993	1994	1995	1996	1997
Cement, hydraulic e/	thousand metric tons	114	87 r/ 3/	96 r/	100 r/	20
Gold, mine output, Au content e/	kilograms	5	12 3/	10 r/	10	10
Lime e/	metric tons	240	390 3/	390	390	390
Liquid petroleun gas e/	thousand 42-gallon barrels	--	--	--	3,650 e/	4,380 3/
Petroleum, crude	do.	76,708 r/	67,525 r/	63,875	80,300 r/	98,550 3/

e/ Estimated. r/ Revised.
1/ Includes data available through June 1999.
2/ Natural gas is also produced, but all of it is vented or flared.
3/ Reported flgure.

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THE MINERAL INDUSTRY OF

CONGO (KINSHASA)

By George J. Coakley

Following the military victory of the Alliance of Democratic Forces for the Liberation of Zaire-Congo (ADFL), which was opposed to the former Government of Zaire, the country was officially renamed the Democratic Republic of the Congo [Congo (Kinshasa)] on May 29, 1997. Located in the heart of equatorial central Africa, Congo (Kinshasa) has an area of 2,267,600 square kilometers (km²), about one-quarter the size of the United States. The area supported a population of about 49 million in 1997 with a gross domestic product (GDP) per capita of $400 based on 1996 purchasing power parity data. Disruptions caused by the civil war in 1997 and the uncertain investment policies of the new government were a setback to the proposed new mineral development needed to revitalize the mineral economy of Congo (Kinshasa). Historically, the mining industry accounted for 25% of GDP and about three-quarters of total export revenues. The near collapse of the economy, however, has made it difficult to sustain normal mining activities.

The state-owned La Générale des Carrières et des Mines (Gecamines), formerly the nation's major foreign currency export earner, continued its struggle to maintain copper production at from 5% to 10% of capacity. A program begun in 1994 to focus on high-unit-value cobalt production gave some returns as cobalt mine production increased 25% and refined cobalt, with a focus on the processing of stockpiled cobalt hydrates, increased by 52% in 1996 compared with those of 1995. With stockpiles depleted and with productivity impacted by the war, refined cobalt production declined by 50%, to 3,000 metric tons (t), in 1997.

The deterioration of the overall economy and the lack of reinvestment of Gecamines revenues in routine maintenance and capital development have contributed to this decline in the industrial mainstay of the economy. With the virtual collapse of the metal mining sector, diamond exports, chiefly from the Kasai Provinces, became the most important source of foreign exchange derived from the mineral sector. Hyperinflation and the further disintegration of the economy continued in 1997 as the internal economies of the key mining provinces of Kasai, Kivu, and Shaba operated almost independently of support from the central Government. The national economy was also adversely affected by the massive Rwandan refugee camps near Goma that affected the northeast region's gold and columbium (niobium) production.

Government Policies and Programs

Legislation has been passed relating to all aspects of the mineral industry. Article 10 of the Constitution states that the soil and subsoil belong to the state. Prospecting, exploration, and exploitation are regulated by Ordinance No. 81-013 of April 2, 1981, and required permits from the Ministry of Mines and Energy.

During 1996 and 1997, the Government was successful in attracting a number of new foreign investors, particularly Canadian junior mining and exploration companies, for new grassroots exploration and joint ventures with Gecamines on the rehabilitation of known copper-cobalt, gold, manganese, and zinc mining properties. Parastal operations targeted for privatization or joint-venture redevelopment included more than 20 copper-cobalt and zinc mines and processing facilities owned by Gecamines, the gold-tin producer Société Minière et Industrielle du Kivu (SOMINKI), the major diamond producer Société Minière de Bakwanga (MIBA), and the major gold producer Office des Mines d'Or de Kilo-Moto (Okimo). In 1997 over 100 preliminary agreements for exclusive exploration zones (ZER or zones exclusives de recherche) had been signed and another 200 were pending. The projects held the potential for between $2 billion and $3 billion in new investments needed to revitalize the Congolese mining industry. Uncertainty, however, was raised among the international mining and financial communities in late 1997 and January 1998, when the new Government canceled or questioned the legality of a number of exploration and mining agreements. Claiming that the companies "had been dragging their feet instead of starting work," the Government canceled mining exploration agreements with 12 companies (Business Day Online, January 27, 1998. Congo scraps 12 mining research deals, accessed January 27, 1998 at URL http://www.bday.co.za/98/0127/news/n14.htm). The government also questioned the validity of agreements held by American Mineral Fields Inc. on its Kolwezi copper-cobalt tailings project and Ashanti Goldfields Company Ltd. on the Okimo gold mine. During the year, the new Government canceled a diamond marketing agreement between MIBA and De Beers Centenary AG and the management contract for the South African company operating the State-owned railroad, Sizarail.

Production and Trade

As estimated in table 1, production of most commodities declined sharply in 1997. Diamond production appeared to be up, but exact figures are uncertain owing to the high level of smuggling and undocumented production. Crude petroleum production remained constant at around 29,000 barrels per day (bbl/d). The more-significant mineral commodities exported were cobalt, copper, diamond, gold, and crude oil. Historically, the main trading partners of Congo (Kinshasa) were Belgium, France, Germany, Japan, South Africa, and the United States.

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Structure of the Mineral Industry

The Government maintained at least part ownership and generally majority ownership, of nearly all the productive and service sectors of the economy. Gecamines, the principal parastatal company, produced essentially all of the country's coal, cobalt, and copper. Gecamines also operated subsidiaries that produced cement and other materials required for its primary mineral interests. MIBA, which was 80% owned by the Government, produced about 25% of industrial diamond production with the remainder coming from small artisanal operators. Sominki and Okimo were the other principal parastatal mining companies.

Commodity Review

Metals

Copper and Cobalt.—Gecamines holdings in the Copperbelt of Shaba Province contain one of the greatest concentrations of high-grade copper and coproduct cobalt resources in the world; since 1993, in particular, most mining operations, however, have come to a standstill; total capacity utilization was at less than 10%. Gecamines faced multiple crises in finance, production, and transportation. The company's poor condition was attributed to a combination of aging equipment; lack of domestic and international investment; lack of spare parts; shortages of fuel, lubricants, and sulfuric acid; problems with transporting ore and finished products; theft of finished products; debts owed to the state electricity company and Sizarail; flooding of open-pit mines; and the inability to retain professional and other personnel because of disruptions caused by tribal conflicts and other factors.

Under Gecamines survival plan, initiated in 1994, cobalt became the company's primary foreign currency earner in the past few years. Treating stockpiled cobalt hydrates, Gecamines brought total refined cobalt metal production up to 4,000 t in 1995 and 6,000 t, with a market value of nearly $340 million, in 1996, dropping back to 3,000 t in 1997. To attract the capital needed to revitalize operations, Gecamines was using joint ventures with foreign investors and retaining up to 49% equity interest in these joint venture arrangements; most ranged from 20% to 45%. In addition to treating stockpiled hydrates, Gecamines planned to start up production at three small-scale cobaltiferous mines at Kababankola, Kasombo, and Twilezembe, and to rehabilitate metallurgical facilities at Kamoto and elsewhere. Gecamines had 23 cooperative projects, including development of the Tenke-Fungurume deposits that it hoped would return production levels of copper to 400,000 t and cobalt to 25,000 t by 2000 (Swana, 1998).

In April 1997, Gecamines signed an agreement with the OM Group, Inc. (OMG) of the United States, one of world's largest consumers of refined cobalt, and l'Enterprise Generale Malta Forrest SPRL (EGMF) to reopen the Luiswishi copper-cobalt mine, which had been closed since 1962. EGMF agreed to develop the mine and to build a new concentrator. OMG, in turn, agreed to purchase all concentrate production to feed its OMG Kokkola Chemical plant in Finland. Luiswishi reopened in November 1997; the project was scheduled to produce 13,300 metric tons per year (t/yr) copper and 2,800 t/yr cobalt over a 13- to 15-year life of operations (Business Day Online, [November 11, 1997], Forrest reopens Luiswishi mine, accessed November 12, 1997 at URL http://www.bday.co.za/97/1111/world/w17.htm). In June 1997, the OMG and EGMF signed a contract with Gecamines to build a 5,000 t/y cobalt smelter in Lubumbashi to produce cobalt-copper alloys from concentrate converter slags. The $18 million slag treatment plant was scheduled to be completed within 2 years by the Finnish company, Outokumpu Oy. The alloy product will be sent to OMG's Kokkola refinery in Finland for final processing (OM Group, Inc. June 25, 1997, OM Group signs cooperation agreement to build smelter in Congo, press release, accessed July 8, 1997 at URL http://www.omgi.com/pressrelease/062597.htm).

In September 1997, International Ballater Resources Inc. and First Quantum Minerals Ltd. of Canada, through its 70% owned International Quantum Resources Ltd. (IQR), signed a preliminary agreement with Gecamines to acquire the rights to two tailings dumps at Kingamiambo and Luilu in the Kolwezi district. Gecamines data for 35 years of tailings from the Dima, Kamoto, and Kolwezi concentrators dumped at Liulu indicated a dump size of 20 million to 30 million metric tons (Mt) containing approximately 2% to 3% copper and 0.2% to 0.4% cobalt. Gecamines estimated the tonnage and grade of the Kingamiambo dumps to be between 15 and 25 Mt at between 1% and 2% copper and 0.1% and 0.3% cobalt. IQR will acquire a 51% interest in the two dumps by carrying out feasibility studies and financing 100% of development costs (First Quantum Minerals Ltd., September 15, 1997, Announce acceptance of proposals to acquire tailings dumps, news release, accessed October 27, 1997 at URL http://www.first-quantum.com/news_97/091597.html).

Union Miniere (UM) of Belgium, in joint venture with Gecamines, operated the rehabilitated Kasombo cobalt mine and upgraded the Shituru hydrometallurgical cobalt processing plant near Likasi in 1997. The cobalt plant was expected to increase cobalt recoveries by several hundred tons per year.

Formally ratified by the new Government in June 1997, International Panorama Resources Corp. (IPR) of Canada had acquired 51% working interest from Gecamines in August 1996 to reprocess copper/cobalt tailings from Kambove and Kakanda mines; Gecamines was to receive a 1.5% royalty of the net profits after the capital payback period. Gecamines estimated the resource in tailings to be 61 Mt averaging 0.98% copper and 0.19% cobalt. Metallurgical tests by IPR suggested that the Kambove tailings were uneconomic owing to excessive acid consumption. During 1997, IPR spent around $4 million on the project principally on a feasibility study of the Kakanda project conducted by Bateman Minerals & Industrial Ltd. of South Africa. The study outlined a "defined tailings reserve" of 18.4 Mt grading 1.22% copper and 0.15% cobalt and "measured minable open pit resource" of 11.3 Mt grading 3.14% copper and 0.19% cobalt. The study called for a capital cost of $270 million to treat 3 million metric tons per year (Mt/yr) of tailings for the first 7 years and then 2 Mt/yr of new mined material for an additional 7 years. The project would include an acid plant, an agitated vat leach stage, and a solvent extraction-electrowining plant designed to produce 3,500 t/yr of cobalt cathodes and 54,000 t/yr of copper cathodes. Long-term commodity prices used for the feasibility

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study, which projected a 2-year capital payback, were $11 per pound for cobalt and $1 per pound for copper (International Panorama Resources Corp., October 23, 1997, Feasibility study confirms economic viability of copper/cobalt project in Democratic Republic of Congo, press release, accessed November 12, 1997, at URL http://www.intlpanorama.com/news/oct23.html).

An agreement between AMF and the new government on the Kolwezi project and its exploration program was ratified on April 16, 1997. Under the agreement with Gecamines, AMF can earn a 51% interest in the Kolwezi copper-cobalt tailings project with a capital investment of $350 million. The Kolwezi resource contained 104.5 Mt of tailings grading 1.34% copper and 0.26% cobalt. Plans called for construction of a processing plant to recover 50,000 t/yr of copper and 6,000 t/yr of cobalt. On December 31, 1997, AMF reported receiving a communique from Gecamines that " the tender process had not met the needs of the nation and that it had been terminated until a new arrangement could be put in place" (American Mineral Fields Inc., December 31, 1997, Congo negotiations update, news release, accessed January 6, 1998, at URL http://www.am-min.com/amf/96/news/dec31-97.html). On January 7, 1998, AMF announced that they were suing Anglo American in a Texas court for $3 billion claiming that Anglo American had "interfered with the company's agreements (with respect to the Kolwezi tailings project) in the Democratic Republic of Congo" (American Mineral Fields Inc., January 7, 1998, American Mineral fields launches US$3 billion Texas legal action against Anglo American/De Beers/ Minorco Group, news release, accessed January 8, 1998, at URL http://www.am-min.com/amf/96/news/jan7-98.html). The Chairman of Gecamines subsequently released a clarification of its position regarding the AMF agreements in which he claimed: a June 1997 pre-feasibility study on the Kipushi Mine rehabilitation project by AMF was not adequate to meet Gecamines expectations; a study on the Kipushi tailings retreatment plant had yet to be submitted; no progress had been made on the exploration program; and raised questions on irregularities in the agreement on Kolwezi (M.K. Swana, January 20, 1998, Letter from Chairman, Gecamines to The Marek Enterprise, Inc., Reston, Virginia, USA, on clarification from Gecamines relating to the Kolwezi concentrator tailings project, accessed February 19, 1998 at URL http://www.marekinc.com/AflsBusMine012098.html). According to other reports Gecamines also expected bidders on its various project agreements to make substantial up-front cash payments in exchange for Gecamines equity released and to accelerate project work (Metal Bulletin, 1998). In early 1996, AMF had entered into an agreement with Gecamines covering the following areas: the rehabilitation of the Kipushi underground zinc mine and concentrator; the creation of a joint venture to construct a zinc tailings treatment plant and a new zinc refining plant at Kipushi; exploration on two of Gecamine's exclusive research zones for copper and tin in southern Shaba Province; and the reprocessing of copper and cobalt tailings at the Kolwezi concentrator. In May 1996, AMF concluded a Heads of Agreement with Anglo American Corporation of South Africa Limited. Under the agreement, Anglo American could contribute up to $100 million in equity funding to earn a 50-50 interest in a joint company with AMF on the Kipushi and the Kolwezi projects.

Anvil Mining NL of Australia acquired a 90% interest in the Dikulushi copper-silver project in southeastern Congo (Kinshasa) near the Zambian border west of Pweto and Lac Moero in September 1996. The mining convention, covering a 12,945-km^2 area, was formally signed in January 1997. During 1997, work began on due diligence exploration drilling aimed at defining a shallow open-pitable resource and on a prefeasibility study on the Dikulushi project. Previous work by the Bureau de Recherches Géologiques et Minières of France in the 1970's was reported by Anvil as a measured and indicated resource of 1.66 Mt grading 11% copper and 310 grams per metric ton (g/t) silver at Dikulushi (Anvil Mining NL, February 3, 1997, Dikilushi copper silver project, Australian Stock Exchange announcement, accessed July 8, 1998 at URL http://erd.pair.com/Anvil_Mining/avl0203.htm). Preliminary metallurgical tests indicated that the copper mineralization was amenable to flotation and that a 60% copper concentrate could be produced with high silver credits (Anvil Mining NL, 1998, Annual report of Anvil Mining NL for 1997, Review of operations, accessed July 8, 1998 at URL http://erd.pair.com/Anvil_Mining/ar97.htm). Work plans for 1998 called for completion of the Dikulushi feasibility study and the beginning of underground sampling and surface exploration of the Kapulo copper project within their concession area. The Kapulo area contained a number of small, high-grade chalcocite vein deposits that had not been worked since the late 1950's. In August 1997 First Quantum Minerals Ltd. acquired a 10% equity interest in Anvil Mining.

In November 1996, the Canadian company, Consolidated Eurocan Ventures Ltd., a subsidiary of Lundin Holdings Ltd. of Bermuda, acquired a 55% interest in the Tenke-Fungurume copper deposits from Gecamines. In January 1997, Consolidated Eurocan Ventures changed its corporate name to Tenke Mining Corp. (TMC). Gecamines will retain a 45% equity interest and receive compensation of $250 million in three installments from TMC. Following a renewal of the accord with the new Government, TMC paid the first installment of $50 million to Gecamines on May 7, 1997; $40 million will be due 130 days after completing a favorable feasibility study, and a final payment of $160 million will be due on May 7, 2003. Based on geological data gathered in the 1970's when efforts were first being made to develop the property, the company estimated the known Tenke-Fungurume resources to be 222 Mt grading 4.42% copper and 0.33% cobalt and proven reserves to be 92.6 Mt grading 4.59% copper and 0.36% cobalt (Tenke Mining Corp., 1997c). To put the high grade of the copper ore of the Tenke-Fungurume deposits and the low-unit-cost potential of this project in perspective the copper grade is more than eight times richer than the average grade of copper ore mined in the United States (0.57%). A $ 6 million exploration program and a $12 million feasibility study were initiated in April 1997. The feasibility study was based on constructing an open-pit mine and copper recovery plant designed to produce 100,000 t/yr of copper metal and 8,000 t/yr of cobalt metal during a first phase with a later expansion to 400,000 t/yr of copper. Initial operations would be solely vat leach oxide ore treatment with sulfide facilities added in eighth year of operations (Tenke Mining Corp., 1997b). Subject to completion of the feasibility study, arrangement for project financing, and continued political stability in the country, the first phase of the project was planned to begin production during 2000 at a cost of $390 million. Exploration during 1997

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was centered in the Dipeta syncline, located between the known the Tenke and the Fungurume copper-cobalt deposits. On the basis of the results of a 37 hole drilling program to 500 meters depth in the Dipeta syncline, TMC reported a new drill-indicated resource of 197 Mt grading 4.37% copper and 0.22% cobalt, thus nearly doubling the concession's resource estimate. Included within the top 100 meters of the Dipeta resource estimate was a high-grade supergene enriched zone of oxides containing 50 Mt grading 5.22% copper and 0.26% cobalt. The balance of deeper sulfide resources was 147 Mt grading 4.08% copper and 0.21% cobalt (Tenke Mining Corp., 1997a).

Gold.—In January 1996, Banro Resource Corp. of Canada, through its wholly owned subsidiary, African Mineral Resources Inc., in conjunction with its joint-venture partner, Mines d'Or du Zaire (MDDZ) purchased a 64% interest in SOMINKI for $3.5 million. Banro and MDDZ jointly controlled 72% of the gold, tin, and tantalum mines and of the land holdings of SOMINKI with the balance retained by the Government. The company owned 10 mining permits and 47 mining concessions covering 10,271 km^2. Included in the gold holdings southwest of Bukavu in Kivu Province are the producing Kamituga-Mobale underground gold mines which Banro estimated to contain resources of 124,414 kilograms (kg) of contained gold on the basis of past work by SOMINKI, the Twangiza property containing proven and probable open pit oxide reserves of 5.5 Mt grading 4.3 g/t, with possible minable sulfide reserves of 2.7 Mt containing 4,600 kg of gold; the Lugushwa property containing resources on two of its areas of 3 Mt of 4.5 g/t of gold and 2.5 Mt of 4 g/ of gold; and the closed Namoya Mine with reported minable sulfide reserves estimated to be more than 9,330 kg of contained gold. In January 1997, Banro signed a new mining convention with the Government increasing Banro's interest in SOMINKI to 93%, with the Government retaining a 7% carried interest. At the same time, all assets of SOMINKI were transferred into a new company, SAKIMA S.A.R.L. Banro agreed to invest $15 million and received a 10 year-post production tax moratorium, an elimination of import duties, and the right to export all gold production (Banro Resource Corp, January 31, 1996, Banro completes purchase of SOMINKI S.A.R.L. (Zaire): press release, accessed March 18, 1998, at URL http://www.banro.com/releases/01-31-96.html).

The Mobale gold mine was overrun and flooded during the civil war and forced to close in early 1997, leading SAKIMA to shift the exploration emphasis to the Namoya and the Twangiza deposits. The Mobale Mine and 300-metric-tons-per-day mill produced at a rate of 311 kilograms per year (kg/yr) of gold before closing. Following the June 1997 confirmation of Banro's rights to the concession by the ADFL Government, SAKIMA put into action its $10 million exploration and development plans. On the basis of work through yearend 1997, SAKIMA contractor, CME & Company of Canada, revised resource estimates at the Twanziga deposit to 107 Mt grading 1.96 g/t of gold. A new CME analysis of historical data on five separate gold deposits in the Namoya area produced a total resource of 8.1 Mt grading 3.47 g/t of gold, including an indicated high grade resource of 85,175 t averaging 49.03 g/t of gold. The $3.7 million Phase II program at Twanziga, including additional exploration drilling, metallurgical work, and a pre-feasibility study, was scheduled to be completed by the end of 1998 (Banro Resource Corp., 1998).

In September 1997, the ADFL Government revisited two concession agreements in the Kilo-Moto goldfields in the Bunia area in northern Congo (Kinshasa) near the Ugandan border. The Government was renegotiating with Barrick Gold Corp. of Canada over the size of its concession. In an effort to attract more investors, the Government wanted to reduce Barrick's original 83,000-km^2 exploration concession surrounding the Kilo-Moto gold fields of August 1996 to between 5,000 and 20,000 km^2. At the Okimo gold mines, which had been sold in 1997 and renamed Kilo-Moto Mining International S.A.R.L. (Kimin) the Government suspended operations claiming that the Belgian-owned, Mindev company had failed to meet its investment and development commitments. Production at Kilo-Moto in 1997 was around 50 to 60 kg/yr with the potential for a major increase. The government also questioned the equity ownership share that Mindev claimed to hold in Kimin—49% vs. 82.5%, respectively (William Wallis, September 10, 1997, New Congo terminates Kilo-Moto gold contract, accessed September 10, 1997, at URL http://biz.yahoo.com/finance/97/09/10/abx_asl_y_1.html). Subsequently Ashanti acquired Mindev's share in Kimin for $5 million, but was unable to begin operations owing to legal challenges to the transaction.

Zinc.—Under the terms of its August 1996 agreement with Gecamines, AMF commissioned Bateman to prepare a feasibility study on the reopening the Kipushi zinc-copper mine, rehabilitating the concentrator, and reprocessing the existing tailings; the study was due by April 1998. AMF can acquire a 51% equity interest if a successful feasibility study leads to another agreement with Gecamines to rehabilitate the mine and smelter, which closed in 1993. Preliminary estimates by AMF projected a cost of $30 million to renovate the mine and mill, which produced 143,000 t/yr of zinc and 43,000 t/yr of copper during its peak production year of 1988. It was also a major source of germanium. A feasibility study of building a smelter to produce 200,000 t/yr of zinc, 30,000 t/yr of copper, and 400,000 t/yr of sulfuric acid was underway. Capital costs for the smelter were projected to be around $350 million. An AMF consultant, Watts, Griffis and McOuat of Canada, confirmed Gecamines's estimates of remaining measured resources at 9.9 Mt at 2.51% copper, 0.47% lead, and 9.96% zinc. Combined measured and indicated mineral resources were 20.6 Mt at 2.27% copper, 0.47% lead, and 15.18% zinc. Minable proved and probable reserves, after 10% dilution, were given as 22.6 Mt at 2.06% copper and 13.81% zinc. An addition indicated mineral resource of approximately 16 million cubic meters of Kipushi tailings graded an average 0.36% copper, 1.62% lead, and 2.25% zinc (American Mineral Fields, Inc., The Kipushi project, Zaire, accessed September 22, 1997 at URL http://am-min.com/96/kipushi/kproj.html).

Industrial Minerals

MIBA, the major official diamond producer in Congo (Kinshasa), accounted for about 40% of official diamond exports, from mining operations in Mbuji Mayi in Kasi Province. MIBA was owned 80% by the Government and 20% by the Belgian

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company Sibeka, which is owned by UM (79%) and De Beers (20%). MIBA produced more than 6.8 million carats per year, valued at $70 million, of near-gem quality stones annually, about one-fifth of the annual estimated diamond production of Congo (Kinshasa) (Diamond International, 1997). With its alluvial deposits nearing exhaustion, MIBA planned to invest $100 million during the next 5 years to shift production to six kimberlite pipes on its property, which accounted for only 20% of production. MIBA expected one-half of production to come from kimberlites within 2 years (Wrong, 1997). Until mid-1997, De Beers purchased all MIBA's industrial diamond output under an exclusive contract, which was canceled by the ADFL Government. Beginning in June, MIBA diamond production was being sold in open international auction to the highest bidder. The Government's Centre National d'Expertise estimated that more than one-third of the country's diamond production worth, about $300 million, is smuggled out each year (Mining Journal, 1996; Mulenga, 1997).

Mineral Fuels

Zaire Gulf Co., which is controlled by Chevron Corporation (United States—50%), Teikoku Oil Co. Ltd. (Japan—32.3%), and Unocal Corporation (United States—17.7%) produced approximately 75% of the nation's 29,000 bbl/d of crude petroleum from around 35 offshore wells. The only domestic oil refinery, at Muanda, had a rated capacity of 17,000 bbl/d; data on current operating levels, however, were not available.

Reserves

Major mineral resources were generally considered to be sufficient for many years of production, with known copper ore grades running two to eight times the grade of typical copper ore mined in North America and South America. Reserve data on copper, cobalt, gold, and zinc, however, have not been updated for several years and must be reevaluated in light of current (1997-1998) economic conditions in Congo (Kinshasa) and the deterioration of Gecamines and other facilities. At yearend 1997, reserves of oil and gas were 187 million barrels of oil and 1.4 billion cubic meters of natural gas (PennWell Publishing Co., 1998). As of 1996, estimated recoverable coal reserves were 88 Mt (U.S. Energy Information Administration, August 1998, Southern African Development Community, Table 5. SADC energy overview—coal, accessed at URL http://www.eia.doe.gov/emeu/cabs/sadc.html).

Infrastructure

Congo (Kinshasa) is an essentially landlocked country, with only a small coastal area on the Atlantic Ocean. Operations at the 2-million-metric-ton-per-year port of Matadi, with a 160-kilometer river approach, have suffered from crime and civil unrest in the country. Water falls below Kinshasa make the Congo River unnavigable to the sea and limit the significance of the world's second largest river as a significant export route, although it is a key inland commercial route.

A combination of railroad, road, and riverboat transport were used to move equipment, food, and other supplies into the mining and mineral-processing regions and ores, concentrates, and finished mineral products. Even prior to the breakout of civil war, much of this transport network was in varying degrees of disrepair. Locomotive and rolling stock shortages were also a problem. The Sizarail line was a critical logistical support link for the diamond industry between the Zambian border and Mbuji-Maya.

The major companies involved in transportation are Government owned. Small private trucking and riverboat companies provided limited local service. Historically, mineral products were shipped at times from the Copperbelt west on the Voie Nationale, a difficult road-rail-water route, to the Matadi seaport, the only transport route entirely within the country; through Zambia on the Tazara railroad to the port of Dar es Salaam in Tanzania; and through Zambia to southern rail lines leading to bulk-loading export ports in South Africa. Copper shipments could take 45 days to get from the plant to the dock, either south via Zambia and Zimbabwe or eastward along the Tazara railroad. Owing to rail and river transport problems, most cobalt and copper wirebar products were shipped via truck convoy to the port of Durban in South Africa. High-value cobalt, diamonds, and gold can be flown out of the country.

Shaba Province, the site of most of the country's mining activity, historically consumed almost 50% of the nation's generated electrical power. A portion of the electricity used in the Shaba region was delivered by the 1,800-km long, 560-megawatt Inga-Shaba transmission line, which runs from the Inga Dam on the Congo River south of Kinshasa to the Copperbelt city of Kolwezi in Shaba Province. Nevertheless, the tremendous hydroelectric potential of the Congo River remains largely untapped. For energy requirements at its mine and metallurgical operations, Gecamines was dependent on imported coke and refined petroleum products

Outlook

The short-term economic prospects for Congo (Kinshasa) are poor and further threatened by civil wars and turnover in Governments, refugee problems and ethnic conflicts in the eastern provinces bordering Rwanda and Uganda. The recent decline of copper and cobalt production had led to the deterioration of the country's most important company, Gecamines. Despite almost insurmountable operating difficulties, Gecamines continued to operate, albeit at limited capacity. Changing Government policies promoting privatization of the state-run mining sector to attract new foreign capital and technical expertise holds some hope for the future, but requires stronger guarantees of property title and investment security by the new Government. Because of its size and wealth of resources of Congo (Kinshasa), long-term potential was more promising, and the country could remain an important supplier of copper, cobalt, diamond, and zinc for years. The future prospects for economic development of Congo (Kinshasa) depend on its ability to achieve political and economic stability, to mobilize its resources, to control Government spending, and to attract new foreign investment.

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Major Source of Information

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TABLE 1
CONGO (KINSHASA): PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
METALS						
Cadmium, smelter		12	--	--	--	--
Cobalt:						
Mine output, Co content		2,459	826	1,647	2,000 e/	3,500 e/
Metal, Co content:						
Refinery (salable products)		829	2,330 r/	3,410 r/	3,491 r/	2,808
White alloy, matte		1,263 r/	945	557 r/	2,546 r/	195
Total		2,092 r/	3,275 r/	3,967	6,037 r/	3,003
Columbium and tantalum:						
Columbite-tantalite concentrate:						
Gross weight	kilograms	20,000 e/	4,120	--	--	--
Cb content e/	do.	5,000	1,000	--	--	--
Ta content e/	do.	5,700	1,000	--	--	--
Pyrochlore concentrate: e/						
Gross weight	do.	780,000	--	--	--	--
Cb content	do.	350,000	--	--	--	--
Copper: 2/						
Mine output:						
By concentration or cementation		6,900	7,200	6,800	6,200	--
Leaching (electrowon)		39,400	22,800	22,600	43,800 r/	40,100
Total		46,300	30,000	29,400	50,000 r/	40,100
Metal:						
Smelter, primary:						
Electrowon (low grade)		37,100	22,800	22,600	43,800 r/	40,100
Other		5,700	7,200	6,200	6,000	--
Total		42,800	30,000	28,800	49,800 r/	40,100
Refinery, primary:						
Electrowon		2,300	--	--	--	--
Other		34,100	29,000	33,000	42,200 r/	40,100
Total		36,400	29,000	33,000	42,200 r/	40,100
Gold 3/	kilograms	1,502	780	1,180	1,252	394
Silver e/	do.	11,000	900	900	900	900
Thorium, monazite concentrate, gross weight e/ (55% rare-earth oxides)		20	--	--	--	--
Tin:						
Mine output, Sn content		700 e/	100 r/	-- r/	-- r/	--
Smelter, primary e/		50	50	--	--	--
Zinc:					--	--
Mine output, Zn content		6,830	500 r/	4,500 r/	3,200 r/	1,600 r/
Metal, primary, electrolytic		4,150	--	--	--	--
INDUSTRIAL MINERALS						
Cement, hydraulic		149,000	150,000 r/ e/	200,000 r/ e/	240,790 r/ 4/	124,881 4/
Diamond: e/						
Gem	thousand carats	2,000	3,000	4,000	3,000	3,300
Industrial	do.	13,600	13,300	13,000	17,600	18,900
Total	do.	15,600 4/	16,300	17,000	20,600	22,200
Lime e/		50,000	50,000	50,000	50,000	50,000
Stone, crushed e/		200,000	200,000	100,000 r/	100,000 r/	100,000
Sulfur:						
S content of sulfuric acid from sphalerite e/		2,000	--	--	--	--
Sulfuric acid, gross weight:						
From sphalerite		6,000 e/	--	--	--	--
From imported sulfur		10,000 e/	15,000 e/	--	--	--
Total		16,000 e/	15,000	--	--	--
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/		14,000 4/	11,000 4/	70,000 r/	95,000 r/	50,000 e/
Petroleum:						
Crude	thousand 42-gallon barrels	8,285	9,125	10,220	10,000 e/	10,600 e/
Refinery products:						
Liquefied petroleum gas e/	do.	25 r/	25 r/	25 r/	25 r/	25
Gasoline	do.	365	365	365	365 r/	365 e/

See footnotes at end of table.

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TABLE 1--CONTINUED
CONGO (KINSHASA): PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Petroleum--Continued:						
Refinery products--Continued:						
Kerosene and jet fuel	thousand 42-gallon barrels	545 4/	545 4/	500 r/	500 r/	500
Distillate fuel oil	do.	365	365	730 r/	730 r/	730 e/
Residual fuel oil	do.	1,095	1,095	1,095	1,095 r/	1,095 e/
Refinery fuel and losses	do.	1,000 r/	545 5/	1,100 r/	1,100 r/	1,100 e/
Total	do.	3,395 r/	3,395 r/	3,815 r/	3,815 r/	3,815 e/

e/ Estimated. r/ Revised.
1/ Table includes data available through May 10, 1999.
2/ Terms are used as defined by the International Copper Study Group.
3/ Reported by La Banque du Zaire. Unreported production may be higher.
4/ Reported figure.
5/ Includes "Other."

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THE MINERAL INDUSTRY OF

CÔTE D'IVOIRE

By Philip M. Mobbs

Primarily an agrarian economy, Côte d'Ivoire's mineral industry made a modest contribution to the nation's gross domestic product. The country's Birimian greenstone geology has, however, attracted considerable attention from international gold exploration companies. Nonfuel mineral production was relatively meager. *(See table 1.)* The state mining company, Société pour le Développement Minier, had documented numerous mineral deposits, including bauxite, brick clay, ilmenite, iron ore, manganese, lateritic nickel, rutile, glass sand, dimension stone, and tantalite (Ministère des Mines et de l'Energie, 1994). For more extensive coverage of the mineral industry of Côte d'Ivoire, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

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TABLE 1
CÔTE D'IVOIRE: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1993	1994	1995	1996	1997
Cement	thousand metric tons	500	500	500	500	500
Diamond	carats	15,000	84,400	75,300	301,591 r/ 3/	306,665 3/
Gold	kilograms	1,500	1,860	1,983 3/	1,883 r/ 3/	2,419 3/
Natural gas	million cubic meters	--	--	36	547 r/ 3/	879
Petroleum:						
Crude	thousand 42-gallon barrels	--	--	2,000	5,833 r/ 3/	5,334 3/
Refinery products	do.	18,300	19,300	19,300	7,620 r/ 3/	7,850 3/
Tantalite	kilograms	--	--	500	500	1350 3/

r/ Revised.
1/ Includes data available through November 23, 1998.
2/ In addition to the commodities listed, Côte d'Ivoire produced clays, crushed granite, sand and gravel, and stone for the local construction industry. Information is inadequate to make reliable estimates of output levels.
3/ Reported figure.

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THE MINERAL INDUSTRIES OF

DJIBOUTI, ERITREA, AND ETHIOPIA

By Philip M. Mobbs

Djibouti

The few reports available in recent years on mineral industry activity in Djibouti indicated intermittent entrepreneurial production of small quantities of limestone and construction materials, including clays, sand, gravel and crushed stone, as well as some marble and granite dimension stone. Artisanal salt production at Lake Assal has been displaced by small-scale commercial operations. Other mineral occurrences of potential economic interest include diatomite, geothermal fluids and mineral salts, gold, gypsum, perlite, pumice, and, possibly, petroleum. Most of these are near Lake Assal, although some gold indications were further west near Yoboki and in the south near Ali Sabieh.

The Government was trying to attract foreign investment to develop the mineral industry. In December 1997, the joint venture of Quest International Resources Corp. of the United States and Seven Star Minerals received exploration permits for several base and precious mineral prospects.

Djibouti was attempting to recapture some Ethiopian foreign trade from Eritrea, which handled most of Ethiopia's exports in 1997. Rehabilitation of the 781-kilometer (km) Djibouti-Ethiopian railroad was under negotiation. The railroad, which had been the major transportation link from Addis Ababa, Ethiopia to the Red Sea, was operated as a joint venture by the Djiboutian and the Ethiopian Governments. The Port Autonome International de Djibouti installed a new wharf and was having the Djibouti shipping channel dredged to about 12 meters.

Eritrea

Eritrea, bordering the Red Sea in northeastern Africa, became an independent nation on May 24, 1993. Agriculture accounted for about 50% of the nation's gross domestic product and the energy and minerals sectors contributed about 1% (U.S. Embassy Asmara, March 1998, Eritrea's economy—Sector report—Mining and energy sectors offer opportunity for U.S., accessed September 16, 1998, at URL http://usialiq.usis.usemb.se/abtusia/posts/ET9/wwwhc01x.html)[1]. To meet the demand for the rehabilitation of the nation's building stock and transportation network, Eritrean mineral production in 1997 was focused on the construction materials sector. Dimension stone, base and precious metals, and petroleum attracted international mineral exploration investment. (*See table 1.*)

The Government, interested in the potential economic enhancement that mineral production and beneficiation could provide, was actively seeking international investment in its mineral industry. The petroleum operations code was issued in July 1993; a general investment code was issued in 1994; and Mining Proclamation No. 68/1995, Mining Income Tax Proclamation No. 69/1995, and Regulations on Mining Operations Legal Notice 19/1995 were issued in March 1995. Royalties were 5% on precious metals and 3.5% on other minerals, the mining corporate income tax rate was 38%, and there was no export tax on minerals. The Government could acquire 10% free interest in new mining investments, and acquisition of an additional 20% equity in the venture by the Government was negotiable.

The Department of Mines, a unit of the Ministry of Energy and Mines (formerly the Ministry of Energy, Mining, and Water Resources), maintained a historical exploration and mining data base. The Ministry awarded exploration and prospecting licenses during formal licensing rounds in September 1995 and November 1997. New applications for mineral property licenses were to be considered according to Mining Proclamation No. 68/1995.

During 1997, the joint venture of Anglo American Prospecting Services (Proprietary) Ltd. of South Africa (60%) and Rift Resources Ltd. of Canada (40%) was granted an exploration license for the Augaro gold property. Rift Resources was also exploring the Ketina and the Nefasit-Mount Subub licenses through its Eritrean-Timmins Resource Ventures plc subsidiary and obtained the Tekeze exploration license in 1997. Ashanti Goldfields Co. Ltd. of Ghana continued exploration and subsequently abandoned its Ketina and Medrezien licenses. LaSource Development Eritrea (La Source SAS of France) drilled the Adi Nefas concession. Ophir Ventures Inc. farmed out 90% of its interest in the Raba and Semait license to Venture Resources Co. of the United States, which prior to yearend, dropped the property. After drilling the Adi Casci, the Adi Rassi, and the Torat targets on its Galla Valley license, Pan African Resources Corp. (PARC) of Canada, a subsidiary of Golden Star Resources Ltd., initiated the cancellation of its interest in the property. Phelps Dodge Exploration Corp. of the United States worked its prospecting licenses. WMC (Overseas) Pty. Ltd. of Australia explored its license areas in the Debub region and the Semenawi Keyih Bahri area.

The Centre pour le Développement Industriel ACP-UE and the Instituto Nazionale per il Commercio Estero sponsored a tour of Eritrean marble quarries by Italian stone-finishing companies.

Anadarko Eritrea Co., a wholly owned subsidiary of Anadarko Petroleum Corp. of the United States, obtained a production-sharing contract on the Edd Block in the Red Sea and was working with reprocessed seismic data on the Edd and the Zula offshore blocks. Azienda Generali Italiana Petroli S.p.A. (Agip) of Italy

[1]Pursuant to Section 1601 of the Foreign Affairs Reform and Restructuring Act of 1998, as contained in Public Law 105-277, this U.S. Information Agency URL was transferred to http://www.usia.gov/abtusia/posts/ET9/wwwhc01x.html.

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subsequently acquired a 30% interest in the Edd and the Zula Blocks. Anadarko and Agip planned exploratory drilling in 1998.

Eritrea's mineral facilities included a 45,000-metric-ton-per-year (t/yr) cement plant at Massawa, the country's main Red Sea port; associated quarries for limestone, clay or shale, and gypsum; and the Orota Iron and Steel Plant. The obsolescent Soviet-built 18,000-barrel-per-day petroleum refinery at Assab, owned by the Eritrean Government and operated by Ethiopian Petroleum Corp., began a 1-year shutdown in August. The Government planned to study options to renovate the plant to reduce the high operating costs. In addition, there were solar-evaporation sea salt plants, each with estimated capacities of more than 100,000 t/yr, near Massawa and Assab; quarries for dimension stone (granite and marble); and sources of silica sand and other raw materials for a 20-metric-ton-per-day glassworks in Asmara. Numerous artisanal gold workings were located south and southwest of Asmara.

Mineral occurrences in Eritrea included a beryl-bearing pegmatite at Shiliki; copper, zinc, and lead sulfides in the Asmara region; many primary gold deposits in the Precambrian terranes west of Asmara; iron deposits east and south of Asmara; and a nickel-chromite deposit in the northwest near the Sudanese border. Other mineral occurrences included asbestos, barite, feldspar, kaolin, petroleum along the mostly desert coastal plain and in the Dahlak Islands offshore of Massawa, potash in the Danakil Depression southeast of Asmara, salt on the Dahlak Islands and the Mineral prospects, and sylvite (Ministry of Energy and Mines, 1997).

The nation's infrastructure, which suffered severe damage from the 30-year Ethiopian civil war that ended in 1991, was being rehabilitated. More than $278 million was earmarked for road construction in 1998 (U.S. Embassy Asmara, February 1998, Eritrea's economy—Sector report—Construction boom, accessed September 16, 1998, at URL http://usialiq.usis.usemb.se/abtusia/posts/ET9/wwwhc01w.html)[2]. The 308-km railroad from Ak'orda through Asmara to Massawa was being rebuilt, and the Red Sea ports at Assab and Massawa were being renovated.

Eritrea was suffering from a severe energy shortage. The nation had approximately 60 megawatts (MW) of electrical generating capacity, fueled by imported diesel. Keangnam Enterprises of Korea was building an 84-MW diesel powerplant at Hirgigo, near Massawa.

The demand for construction and industrial materials is not expected to abate for several years, given the anticipated extensive rebuilding. International mining investment was focused on the sites of historical operations in Eritrea. Disappointing results of exploration on some initial license areas, combined with the drop in the price of gold, made 1997 a frustrating year for the Government and the exploration companies. Exploration activity was expected to rebound as additional mining and petroleum leases are authorized.

[2]Pursuant to Section 1601 of the Foreign Affairs Reform and Restructuring Act of 1998, as contained in Public Law 105-277, this U.S. Information Agency URL was transferred to http://www.usia.gov/abtusia/posts/ET9/wwwhc01w.html.

Ethiopia

The minerals industry was a minor contributor to Ethiopia's economy in 1997. The Government, however, was seeking foreign investment and anticipated that mineral exports could significantly increase the nation's foreign exchange earnings. Gold was the most significant Ethiopian mineral export, whereas fertilizer and petroleum products were the most significant mineral imports. Construction materials, including brick clay, limestone and shale mined for cement production, gypsum for cement and plaster, sand and gravel, and crushed and dimension stone, were also important Ethiopian mineral commodities. A variety of other minerals were also produced. (*See table 2.*)

The Government, through the Ethiopian Investment Authority and the Ministry of Mines and Energy, was promoting mineral sector investment, especially development of known bentonite, coal, columbium, diatomite, natural gas, gold, granite, iron ore, marble, nickel, phosphate, potash, silica sand, soda ash, and tantalum resources.

The Ethiopian Institute of Geological Surveys conducted mapping and mineral prospecting. The state-owned Ethiopian Mineral Resources Development Corp. (EMRDC) was involved in development and production of mineral resources. Mining Proclamation 52/1993, Mining Income Tax Proclamation 53/1993, Mining Operations Regulation 182/1994, Proclamation 22/1996, Proclamation 23/1996, and the Investment Proclamation of June 1996 formed the legal basis for mining in Ethiopia. The Government retained title to all land, and mining operations were subject to national and regional governmental approval. The Government could acquire 2% participation interest in mining ventures and, in 1997, levied a 35% income tax on mining operations. The royalty rate was 5% on precious metals and 3% on other minerals. The November 19, 1997, trade directive establishing hard currency as the basis of exchange between Ethiopia and Eritrea, instead of the Ethiopian birr, resulted in a temporary salt shortage in Ethiopia.

Thirteen companies bid for the 3,000-kilogram-per-year (kg/yr)-capacity Lega Dembi gold mine that the Government offered to the private sector. Midroc Ethiopia Ltd. submitted the winning bid of $175 million and subsequently transferred operational control to its associate company, National Mining Corp. At yearend, Midroc was negotiating a mining agreement for the Lega Dembi Mine with the Ministry of Mines and Energy. In June, the Ethiopian Privatization Agency solicited bids for the 300-kg/yr Adola gold placer operation. The Ministry estimated that about 1,000 kg/yr was produced by 30,000 to 40,000 people engaged in artisanal gold production (Addis Tribune, March 20, 1997, Illegal gold production and trade rampant, accessed on April 1, 1998 at URL http://addistribune.ethiopiaonline.net/Archives/1997/03/20-03-97/gold.html).

Exploration and production operations in southern and southwestern Ethiopia were severely hampered during October and November by the El Niño rains and associated flooding. The joint venture between Ashanti and Ezana Mining Development plc of Ethiopia explored the Hawsen and the Shire prospects in northern Ethiopia. Ezana Mining was owned by the Tigray regional government. The joint venture of Canyon Resources

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Africa Ltd., a subsidiary of Canyon Resources Corp. of the United States, and JCI Ltd. of South Africa was investigating the Megado Serdo, the Meleka Abeba, and the Tendaho Graben area properties. Emerging Africa Gold (EAG) Inc., an associated company of St. Geneviève Resources Ltd. of Canada, acquired the Agusha-Gumu gold and base metal license and relinquished the Sirkole gold license. During 1997, EAG also dropped the Yubdo platinum property as a result of the noneconomic platinum recoveries reported during metallurgical testing.

EMRDC was exploring for gold in the Oromia region. International Roraima Gold Corp. of Guyana ran geochemical surveys over the Koko-Kenticha property in the Adola gold belt of southern Ethiopia. The joint venture of JCI and Blue Nile International Mining plc of Ethiopia was exploring the Katta-Gulliso property in western Wellega. At yearend, JCI acquired the Werseti-Gudba and the Chambi licenses in the Borena region of southern Ethiopia. National Mining Corp. of Ethiopia held gold exploration licenses at Dawa-Digati and Okote in southern Ethiopia.

PARC released most of the Dul Mountain gold prospect adjacent to the border with Sudan in 1997. After additional exploration, PARC indicated it would surrender the remaining section of the lease property in 1998. Rift Resources held gold exploration licenses for the Humera, the Moyale, and the Negele-Bul Bul prospects. Tan Range Exploration Corp. of Canada was exploring for gold on the Hagere Mariam and the Tulu Kapi concessions and for platinum-group metals on the Blue Nile license. Tan Range entered into an alliance with JCI on two of the licenses.

In 1997, the construction of the 730,000-t/yr capacity Mesebo cement factory near Mekele in the Tigray region was begun, and the production of the Addis Ababa and the Muger cement plants of the state-owned Ethiopian Cement Corp. exceeded their respective capacities. At yearend, the Ethiopian Privatization Agency requested bids on the 20,000-t/yr capacity Dire Dawa cement factory, the smallest of the state-owned cement plants.

Privately owned construction materials operations ranged from local sand and gravel pits to export-oriented dimension stone quarries. EMRDC produced feldspar, kaolin, silica sand, and talc. A 6,000-t/yr kaolin mine in the Borena area and an 8,000-t/yr feldspar and quartz operation at Kentecha began operations in 1997. A permit to explore for salt in the Afar region was issued to Ato Tsegaye Gebreyesus. As part of the Lakes Soda Ash Development Project, EMRDC operated a 20,000-t/yr soda ash plant at Lake Abijata in the Rift Valley about 125 km south of Addis Ababa.

Hunt Oil of the United States acquired a production-sharing contract in the Ogaden region. The Government planned to lease a number of additional areas in the same region. With the closure of the Assab refinery in Eritrea, Ethiopia was expected to import about 830,000 t/yr of petroleum products (Indian Ocean Newsletter, 1997). Partially to offset the need to import petroleum products, Zhongyuan Petroleum Exploration Bureau of China began the development of the Calub Field, west of Shilabo in the Ogaden region, for the Calub Gas Development Share Co., a venture of the federal (90%) and regional governments and private investors. The $5.6 million project was designed to process 186 million cubic meters per year of natural gas and to extract 65,000 t/yr of natural gas liquids from the gas stream. The gas plant was to be operational by 2000. Product distribution was contingent on the national road network being extended into the area (Addis Tribune, May 22, 1997, Agreement to complete eight gas wells signed, accessed on April 1, 1998 at URL http://addistribune.ethiopiaonline.net/Archives/1997/05/22-05-97/wells.html).

The physical infrastructure had limitations, primarily associated with war damage. Roads from Addis Ababa to Assab (about 1,000 km) carried more than 80% of landlocked Ethiopia's exports in 1997. The Government began a massive rehabilitation of the road network. The Government also encouraged increased utilization of the Djibouti-Ethiopian railroad.

Ethiopia's electrical generating capacity of 371 MW was of limited availability outside urban areas. The 75-MW Tis Abay II hydroelectrical powerplant and a 35-MW geothermal powerplant were under construction and hydroelectric plants were proposed for Gilgel Gibe (190 MW), Gojeb (153 MW), and Tekeze (305 MW). Rehabilitation of a 100-MW generator at Finchaa also was contemplated.

Economic development and export growth are expected to increase as improvements in the nation's transportation infrastructure are made. The outlook was for increased activity by domestic and international minerals companies, eventually resulting in increased use of Ethiopia's natural resources.

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TABLE 1
ERITREA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
Basalt		XX	114,483	233,555	509,300	510,000
Cement		XX	45,000 e/	49,947	47,031	50,000
Clays:						
Common		XX	62,970	88,676	81,600	80,000
Kaolin		XX	5,231	3,200	2,620	2,500
Coral		XX	74,404	78,603	69,269	70,000
Feldspar		XX	6,823	--	--	--
Gold	kilograms	XX	78	59	98	350
Granite		XX	43,803	82,007	130,000	130,000
Gravel		XX	80,622	1,172,500	1,715,000 r/	2,000,000
Gypsum		XX	15	20	23	20
Lime		XX	6,294	6,955	7,000 e/	7,000
Limestone e/		XX	60,000	70,000	80,000	80,000
Marble 3/		XX	190	292,400	218,300	220,000
Pumice		XX	183	233	300 e/	300
Quartz		XX	488	276	870	900
Salt		XX	207,836	254,700	200,412	200,000
Sand		XX	464,883	911,508	1,000,000 e/	2,000,000
Silica sand		XX	38,014	966,200	1,481,100	1,500,000
Talc		XX	3	--	--	--
Petroleum products	thousand 42-gallon barrels	XX	5,150	4,336	4,500	3,000

e/ Estimated. r/ Revised. XX Not applicable.

1/ Includes data available through October 2, 1998.

2/ Eritrea became independent in May 1993. Prior production reported under Ethiopia.

3/ In addition to tonnage listed in this table, 108,545 square meters of marble were produced for the construction industry in 1995.

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TABLE 2
ETHIOPIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Cement, hydraulic		350,000	464,396 3/	611,437 3/	650,000 r/	700,000
Clays: 4/						
Brick		15,000	10,000	7,000	7,000	6,000
Kaolin (China clay)		500	8	15	15	16
Diatomite		10	150 3/	150 3/	150 3/	150
Feldspar		10,000	4,000	4,000	4,000	5,000
Gold, mine output, Au content	kilograms	3,387	2,370	4,500 3/	2,500 3/	3,000
Gypsum and anhydrite, crude		2,500	30,700	124,000 3/	124,000 3/	120,000
Lime		100	2,727 3/	3,091 3/	3,100 3/	2,500
Petroleum refinery products	thousand 42-gallon barrels	4,000	--	--	--	--
Platinum, mine output, Pt content 5/	grams	--	--	100	100	100
Pumice 4/		40,000	127,000	360,000	360,000	325,000
Salt:						
Marine		120,000	--	--	--	--
Rock		10,000	5,000	5,000	5,000	5,000
Scoria		8,000	190,000	240,000	250,000	250,000
Soda ash, natural		248 3/	2,150 3/	20,000 3/	20,000 3/	15,000
Stone, sand and gravel: 4/						
Construction stone, crushed	thousand tons	1,000	300	750	750	750
Dimension stone 6/		3,000	42,000	38,000	38,000	40,000
Limestone 7/	thousand tons	100	700	3,215,000	3,300,000	3,300,000
Sand 8/	do.	1,000	6,040	1,600	1,600	1,600
Silica sand		40,000	5,000	6,000	6,000	7,000
Tantalite, concentrate (40% Ta_2O_5)		17 3/	26 3/	20 3/	20 3/	20

r/ Revised.

1/ Data are for year ending July 7 of the year listed. For 1993, some production (particularly cement and component limestone, shale or clay, gold, gypsum, petroleum refinery products, salt, and stone) may be in Eritrea, which became independent in May 1993.

2/ In addition to the commodities listed, some lignite, semiprecious gemstones, steel semimanufactures, and talc reportedly were produced, and silver was reportedly contained in gold ingots from the Lege Dembi Mine, but information is inadequate to reliably estimate output.

3/ Reported figure.

4/ When reported as volume or pieces, conversions to metric tons are estimated.

5/ No platinum production was officially reported after 1988. However, some artisanal platinum probably continued to be produced, and platinum was also reported by others as being contained in gold ingots from the Lege Dembi gold mine, which started up in 1990; but information is inadequate to reliably estimate output.

6/ Includes marble.

7/ Apparently does not include production for cement manufacture for the period 1992 to 1994. Normally, the manufacture of 1 ton of cement requires from 30 to 50 kilograms of gypsum as well as from 1.3 to 1.8 tons of limestone and up to 0.5 ton of shale and/or clay.

8/ May include gravel.

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THE MINERAL INDUSTRY OF

EGYPT

By Bernadette Michalski

The Egyptian economy has been, for the most part, traditionally sustained by mineral and mineral-related industries, particularly by revenues from petroleum and natural gas, the Suez Canal, and the Suez-Mediterranean (Sumed) oil pipeline. In recent years, the hydrocarbons sector accounted for more than 15% of the gross domestic product (GDP); other extractive mineral industries accounted for more than 1% of the GDP, which was $65.48 billion in the fiscal year ending June 30, 1997. The production of crude oil has experienced little change in recent years. Natural gas production has, however, increased steadily with the discovery of new fields and improved technology. In addition to hydrocarbons, Egypt produced a wide variety of metals and industrial minerals. Output of these nonfuel minerals, however, remained relatively low when compared with global levels.

The Mining and Petroleum Code Law No. 66 of 1953 and the Mining Code Laws No. 86 and No. 151 of 1956 are the bases of minerals legislation in Egypt. These laws provide the legal basis for mineral exploration and exploitation. Laws No. 43 of 1979 and No. 50 of 1981 provide the governorates and local councils with the power to administer quarries in their particular districts. Ministerial Decree No. 8 of 1990 was designed to assist the private sector in obtaining the required permits for mining.

The Egyptian General Petroleum Corp. (EGPC) was created under law No. 20 of 1976. Petroleum policy requires exploration permits to be awarded as production-sharing agreements and the conversion of all joint ventures into such agreements.

Law No. 4 of 1994, the unified environmental legislation, empowers the Egyptian Environmental Affairs Agency to enforce environmental regulations and standards at all levels of Egyptian industry. The law also provides that any new mining or quarrying projects will require an environmental impact assessment.

Air pollution concern has prompted the Government to encourage the use of natural-gas-powered motor vehicles. In 1997, Amoco of the United States and the Egypt Gas Company created the semiprivate Natural Gas Vehicle Co., which is converting taxis and other vehicles to natural gas use.

A new crude oil pricing system went in effect as of January 1, 1996. The Government's monthly pricing formula for each of its crude is now expressed as a differential relative to the North Sea Brent crude oil. Oil revenues were $1.397 billion (fiscal year 1996-97), $1.379 billion (fiscal year 1995-96), and $1.323 billion (fiscal year 1994-95).

Egypt's state-run Holding Co. for Metallurgical Industries offered 20% equity in its subsidiary Aluminium Co. of Egypt (Egyptalum) to employees (10%) and private and institutional investors (10%) at the close of 1997. The Government's privatization plans include offering an additional 25% equity in Egyptalum and a 20% equity, valued at $124 million, in the Egyptian Iron and Steel Company Hadisolb.

In 1997, Egypt produced a variety of minerals from more than 600 mines and quarries. Among nonfuel minerals produced in Egypt, phosphate rock and iron ore remained the most important in terms of value. Most other mining activity was on a rather limited scale. *(See table 1.)*

Crude petroleum and refined products (mostly fuel oil and naptha) were Egypt's leading exports in 1997. Asia continued to be the major market for Egyptian crude oil. Israel was also a significant importer, with deliveries of about 11 million barrels (Mbbl). The United States imported 13 Mbbl of crude oil and nearly 600,000 barrels of petroleum products from Egypt (U.S. Department of Energy, Energy Information Administration, 1998a).

Total Egyptian exports were valued at $4.93 billion in fiscal year 1996-97. *(See table 3.)* Oil exports rose to $1.96 billion in fiscal year 1996-97 from $1.58 billion in fiscal year 1995-96. Nonoil exports, however, dropped to $1.45 billion from $1.7 billion during the same time frame. The trade deficit widened from $7.1 billion to $9.78 billion (Arab Petroleum Research Center, 1998, p.78).

Petroleum products, totaling $1.36 billion, also were Egypt's principal mineral import. The United States delivered 12 Mbbl of petroleum products in 1997. Other mineral imports included asbestos, barite, chromite, copper, graphite, iron and steel products, lead, nickel, pumice, silver, sulfur, tin, titanium, tungsten, and zinc. *(See table 4.)* The total value of all imports was $14.7 billion in fiscal year 1996-97 (Middle East Economic Digest, 1998).

Most mining and mineral processing in Egypt is carried out by Government-owned mining companies. *(See table 2.)* Privatization has not progressed as rapidly as was originally planned.

Egyptalum completed installation of the 50,000-metric-ton-per year-(t/yr)-capacity potline at the Nag Hammadi primary aluminum smelter, thus raising total smelter capacity to 230,000 t/yr. The five older existing potlines are to be upgraded by adding an additional 60,000 to 70,000-t/yr capacity by 2002. Equity in Egyptalum was scheduled for public offering in 1996; the partial privatization was delayed because the process of valuation of the company had only been completed at yearend 1996 (Metal Bulletin, 1997b).

Egyptian iron ore was mined in El Gedida area of El Bahariya Oasis in the Western Desert. The nearly 3 million metric tons per year (Mt/yr) produced from this deposit was destined for Hadisolb's Helwan Iron and Steel Works near Cairo; this satisfied about three-quarters of Egypt's demand. About 1 Mt/yr was imported–mostly from Russia. The Egyptian Geological Survey

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& Mining Authority (EGSMA) identified oolitic hematite iron ore deposits in the Eastern Desert about 85 kilometers (km) southeast of Aswan. At yearend, 15 iron ore discovery sites east and southeast of Aswan were opened for development bids. Average iron content at these sites ranged from 65% to 81%, according to EGSMA.

Alexandria National Iron and Steel Co. has completed an expansion and modernization program that will raise output capacity to 1.6 Mt/yr. The expansion program included a $177 million, 800,000-metric-ton-capacity second module for the Midrex direct reduction plant, a $46 million expansion of the steelmaking plant, and a $40 million expansion at the rod-mill plant (Metal Bulletin, 1997a). In late 1997, the company announced plans to build a flat products plant, including a thin-slab casting unit and a hot-rolling coil unit with an annual capacity of 1 million metric tons of sheet steel. The cost of the project was $625 million. Partial financing was to be raised by an offer of company shares valued at $221 million.(Egypt's ANSDK steel co to raise capital, accessed October 16, 1997, at http://biz.yahoo.com/finance/97/10/16/y0023-z00-19.html). Hadisolb is expected to be the first of Egypt's steel mills to transfer to partial private ownership. A minority stake in the company is expected to be offered on the Cairo stock exchange in 1998. The public offering receipts are to be applied to the revamping of the #3 blast furnace at the Helwan plant.

The EGSMA invited gold concession bids in the Al-Oweinat area in Southwestern Egypt and the Allaqi area in the Eastern Desert. The Sukkari gold deposit was under development by Centamin NL of Australia. The company anticipates production by the close of 1998 (Africa Energy and Mining, 1998).

The nation's eight cement companies have a combined installed production capacity of about 20 Mt/yr. A new cement company was formed in 1997–Qena Cement with capitalization of $88.5 million. The private venture company was accepting bids for the construction of a 1.4-Mt/yr-capacity cement plant.

Egypt has four nitrogenous fertilizer complexes, the largest of which is in Abu Qir; the others are in Kima, Suez, and Talkha. The nation's three other fertilizer complexes produce phosphate-base fertilizers. Egypt currently imports about 70,000 t/yr of potassium fertilizers with demand projected to rise to 200,000 t/yr by the turn of the century. BHP Minerals International Exploration Inc. continued exploration for potash deposits in a 14,800-square-kilometer (km^2) area near Ras Gharib on the Gulf of Suez, and the Botas Co. continued exploration over a 14,000-km^2 area in the region of the Gulf of Suez and the Red Sea.

The Government opened the Abu Tartor phosphate mine, about 50 km west of the Kharga Oasis in the Western Desert. When at full production, the annual crude phosphate rock output should reach 4.5 million metric ton (Mt)at 31% P_2O_5, yielding 2.2 Mt of concentrate. The 680-km railway to transport the phosphate from Abu Tartor to Safaga on the Red Sea coast was completed in 1996.

Ilmenite is produced from the Abu Ghalaga Mine in the Red Sea region by El Nasr Phosphate Co. Most of the ilmenite is exported; Europe is the principal destination.

The nation's first coal mine opened in December 1995 in the northern Sinai. Mine production was originally intended for the domestic power industry. The availability of an ample supply of natural gas, however, altered plans, and the coal is now produced for the export market.

Natural gas accounted for 35% of total energy consumption in Egypt in 1997. The Government planned to further utilize natural gas resources through improvements in production, transportation, and infrastructure. Natural gas output is expected to double by 2001.

More than one-half of the nation's total natural gas production is derived from two fields—the Abu Madi and the Badreddin-3 Fields. International Egyptian Oil Co. (IEOC) was the country's leading natural gas producer at 14.87 million cubic meters per day (Mm^3/d) followed by Amoco Egypt Oil Co. (AEOC), a subsidiary of Amoco Producing Co., at 2.55 Mm^3/d. Twelve natural gas plants, with a total capacity of nearly 48 Mm^3/d, operate in three different regions of the country—the Mediterranean region (with more than 50% of the total output), the northern edge of the Western Desert (with more than 30% of the output), and the Nile Delta. Some associated natural gas fields also were in production in the Gulf of Suez and the Sinai peninsula. AEOC and EGPC are considering using recent gas finds on the Nile Delta by developing a $1.2 billion liquefied natural gas (LNG) export project. Under study is a single train plant with capacity to produce 4 billion m^3/yr of LNG. A site west of Port Said has been selected to build the LNG plant and export facilities. The gas is to be eventually delivered to Botas to supply planned gas-fired power stations in the Izmir region of Turkey. Gas sales negotiations are under way among AEOC, EGPC, and Botas. SNAM of Ente Nazionale Idrocarburi Spa (ENI) has taken a 45% interest in the $1.2 billion Egyptian LNG project. AEOC also has 45% and EGPC has 10%. (Italy's SNAM takes 45% stake in Egypt gas project url; http://biz Yahoo, com/finance/971211/italy-s-takes-4-1.html) accessed December 11, 1997.

EGPC has awarded 11 exploration blocks in 1997. The companies involved have proposed to drill 62 wells in total with investment of $208 million. Nine additional blocks are to be offered in the 1998 round.

A total of 15 oil and 20 natural gas discoveries were made in 1997, most of which were made in the Western Desert and in the Nile Delta as a result of advanced seismic acquisition and interpretation techniques. In February 1997, AEOC and IEOC announced discoveries in 2 Nile Delta Blocks. During the year discoveries were announced by Apache Corp., British Gas plc, Khalda Petroleum Corp., Naftex Energy Corp., Petrobel, Repsol Exploration S.A., and Seagull Energy Corp.

Crude oil output has held fairly steady at about 900,000 barrels per day (bbl/d) for the past decade. (U.S. Department of Energy, Energy Information Administration, 1998b). About four-fifths of the country's total output is derived from within the 20,000-km^2 Gulf of Suez basin. AEOC, through the Gulf of Suez Petroleum Co., its joint venture with EGPC, remained the largest oil producer in the country, producing about 360,000 bbl/d. The second largest producer is IEOC, producing about 290,000 bbl/d. Declining yields in more-mature fields have been offset by improved recovery rates in other fields after artificial lift systems were installed.

Egypt's seven refineries have a combined capacity of 604,000 bbl/d and process just over 500,000 bbl/d. The existing refineries

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produce a disproportionately high volume of fuel oil, which accounts for almost 50% of total refinery output. New refining projects are directed toward increasing production of lighter products and decreasing the need for imports. Among these is the Middle East Oil Refinery, a joint venture with Israel. The export refinery, under construction in Alexandria, is scheduled for completion in 1999 and it will be the first refinery in the Middle East to comply with the European Union environmental standards. It is to process about 10 Mbbl/yr of Ras Gharib crude oil (24°API Gravity) and about 25 Mbbl/yr of imported crude oil. The refinery will include a 34,000-bbl/d hydrocracker geared to produce light products and a 33,000 bbl/d naphtha processing unit.

Egypt's first petrochemical complex, to be constructed in Alexandria, is being developed by Sidi Krier Petrochemicals in partnership with banks and insurance companies. The complex will include a 300,000-t/yr-capacity naphtha cracker.

Egypt's crude petroleum reserves were reported to be 3.7 billion barrels. Egypt's natural gas reserves are 918 billion m^3 and include recent new discoveries in the Nile Delta and the eastern Mediterranean Sea. Natural gas reserves have more than doubled since 1993. (Arab Petroleum Research Center, 1998b).

Phosphate rock reserves are 1,270 million tons (Mt), iron ore reserves are 450 Mt, and manganese ore reserves about 1.5 Mt.

Railways within Egypt totaled 5,110 km. There were more than 51,925 km of roadways and 1,171 km of crude oil pipelines.

Commerce transiting the 193.5-km-long Suez Canal is critical to the Egyptian economy. Traffic in the Suez Canal declined to 14,430 vessels from 14,731 in 1996 and 15,041 in 1995. Receipts were $1.80 billion in 1997 and $1.88 billion in 1996—a drop from $1.98 billion during the peak year, 1993. The Suez canal is once again under expansion with plans to increase the maximum draft from 19 meters to 24 meters by 1999. (Arab Petroleum Research Center, 1998c). The canal is presently inaccessible to tankers of very large crude carrier (VLCC) class and ultra large crude carrier (ULCC) class except for transiting in ballast. The 320-km-long Sumed pipeline complements the Suez Canal by linking Ain al-Sokhna on the Gulf of Suez to Sidi Krir on the Mediterranean coast. The pipeline's capacity was increased to 2.4 million barrels per day (Mbbl/d) in late 1995, following a long series of improvements since the Sumed opened in 1977 with a 1.5 Mbbl/d capacity. The pipeline is operated by the Arab Petroleum Pipeline Co.

Installed electrical generation capacity was 14,000 megawatts divided among 37 thermal power stations and 4 hydroelectric plants. About 80% of the electrical output was generated by natural gas with the remainder generated by hydroelectric means. Egypt has embarked on a program that interconnects its power grid with neighboring countries. Already interconnected with the Libyan power grid, future connections with Jordan, Syria, and Turkey were planned.

The allowance of 100% cost recovery on mineral-resource concession agreements should favor future foreign investment.

The country is suffering from high levels of unemployment, and foreign investment and private sector development will be required if further progress is to be made. Following the structural reforms put forth by the International Monetary Fund, the Egyptian economy has become more market oriented and less centralized. The program for 1997 and 1998 includes measures to stimulate the development of the private sector, tariff reductions, and ending import restrictions. The World Bank announced in May 1997 that it would advance Egypt $2.5 billion in grants and loans during the 1997-1998 fiscal year which would include aid of $1.5 billion. While natural gas will be Egypt's main energy and revenue source in the future, development is time and capital intensive. Petroleum output continues to bring in hard currency and new exploration and production techniques continue to augment reserves which have doubled in the past decade. Egypt plans to press ahead with rapid expansion of the gas industry. Oil companies are courting new exploration concessions and the majority of wells drilled to date have yielded oil or gas.

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TABLE 1
EGYPT: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Aluminum metal		178,477	188,464	180,300	179,200 r/	178,200
Copper, refined, secondary		4,600	4,300	4,400	4,600	4,600
Iron and steel:						
Iron ore and concentrate	thousand tons	2,190	3,870	2,043	2,429	2,700 2/
Metal:						
Pig iron	do.	1,325	1,148	1,062	1,100	1,000
Ferroalloys:						
Ferrosilicon		40,100	44,000 r/	44,000 e/	44,000 e/	44,000
Ferromanganese e/		30,000	35,000	35,000	35,000	35,000
Direct reduced iron	thousand tons	837	774	850	830	1,190 2/
Steel, crude	do.	2,772	2,622	2,642	2,618	2,717
Manganese		15,000	15,000 e/	1,207 r/	15,000 e/	10,000 2/
Titanium, illmenite		--	--	57,000	124,000 r/	125,000
INDUSTRIAL MINERALS						
Asbestos		604	514	427	1,836 r/	2,000
Barite		2,535	419	500	-- r/	--
Cement, hydraulic	thousand tons	16,000	17,000	17,665 r/	18,000 e/	18,000
Clays:						
Bentonite		4,994	2,379	1,930 r/	1,136	1,200
Fire clay e/		421,000 2/	420,000	420,000	420,000	420,000
Kaolin		184,004	180,000	293,381	258,725 r/	260,000
Feldspar, crude		53,649	39,745	75,049 r/	53,783 r/	50,000
Fluorspar		773	514	551 r/	700 r/	700
Gypsum and anhydrite, crude	thousand tons	1,199	1,481	2,032 r/	2,000 r/	2,000
Lime e/		748,000	750,000	750,000	750,000	800,000
Nitrogen:						
Ammonia, N content	thousand tons	941	1,021 r/	1,096 r/	1,126 r/	1,061 2/
Urea, N content	do.	383	420	480	489	445 2/
Phosphate:						
Phosphate rock	do.	537 r/	632 r/	765 r/	808 r/	900
P_2O_5 content	do.	153 r/	178 r/	207 r/	222 r/	240 2/
Salt	do.	986	1,008	1,990	1,530 r/	1,500
Sodium compounds:						
Soda ash		51,000	50,000	50,000 e/	50,000 e/	50,000
Sodium sulfate e/		25,600 2/	26,000	26,000	26,000	26,000
Stone, sand and gravel: e/						
Basalt	thousand cubic meters	551 2/	600	600	600	600
Dolomite	thousand tons	952	1,000	1,000	1,000	1,000
Granite, dimension	cubic meters	12,900 2/	13,000	13,000	13,000	13,000
Gravel	thousand cubic meters	7,180 2/	7,200	7,200	7,200	7,200
Limestone and other calcareous n.e.s.	do.	18,100 2/	18,000	18,000	18,300 r/	22,000 2/
Marble blocks (including alabaster)	cubic meters	15,800 2/	16,000	45,000	45,000	45,000
Sand:						
Industrial sand (glass sand)	thousand tons	743	740	740	850 r/	1,000
Construction sand	do.	21,700 2/	22,000	22,000	22,000	23,000
Sandstone	thousand cubic meters	180	200	200	200	200
Sulfur: e/						
Elemental, byproduct		4,100	8,000	10,000	8,000 r/	4,453 2/
Sulfuric acid		100,000	100,000	591,000	680,000	500,000
Talc, steatite, soapstone, pyrophyllite		5,297	4,125	38,608 r/	41,227	40,000
Vermiculite		942	1,659	483	447 r/	500
MINERAL FUELS AND RELATED MATERIALS						
Coal e/	thousand tons	--	--	10	200	300
Coke e/	do.	1,180 2/	1,200	1,200	1,200	1,200
Gas, natural:						
Gross production	million cubic meters	11,100	11,900	15,942 r/	16,800 e/	17,000
Dry	do.	8,800	9,000	12,536 r/	13,183 r/	13,349 2/

See footnotes at end of table.

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TABLE 1--Continued
EGYPT: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
MINERAL FUELS AND RELATED MATERIALS--Continued						
Petroleum:						
Crude	thousand barrels	324,850	327,040	335,800	336,500	319,000 2/
Refinery products:						
Liquefied petroleum gas	do.	4,460	4,755	5,325	5,080 r/	6,333 2/
Gasoline and naphtha	do.	33,800	36,900	38,450	40,185 r/	44,065 2/
Kerosene and jet fuel	do.	18,750	17,155	15,770	17,255 r/	16,606 2/
Distillate fuel oil	do.	36,050	39,200	43,550	42,298 r/	43790 2/
Residual fuel oil	do.	77,700	90,080	80,350	85,787 r/	86,100 2/
Lubricants	do.	1,400	1,580	1,645	1,645 r/	1,729 2/
Asphalt	do.	3,700	4,130	4,485	4,181 r/	4,641 2/
Unspecified	do.	2,430	2,250	2,550	2,600 e/	2,400 e/
Total	do.	178,290	196,050	192,125	199,031 r/	205,664

e/ Estimated. r/ Revised.
1/ Table includes data available through September 1, 1998.
2/ Reported figure.

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TABLE 2
EGYPT: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilites	Annual capacity
Aluminum		Aluminium Co. of Egypt (Government, 80%; (private interests, 20%.)	Nag Hammadi	230.
Carbon black		Alexandria Carbon Black Co. (Egyptian Holding Co. for the Chemical Industry, 49%; Inco-Bharat, 36% Grasim Industries 15%.)	Alexandria	20.
Cement		Al Ameriyah Cement Co. (Government, 100%)	Ameriya	2, 100.
Do.		Asiut Cement Co.	Assiut	2,600.
Do.		Helwan Portland Cement Co. (Government, 73%; private interests, 27%.)	Helwan El Minya	2,800. 200.
Do.		Egyptian Cement Co. (Orascom Group, 40%; private interests, 40%; Holderbank Financiere Glaris Ltd., Ltd., 20%)	70 kilometers east of Cairo	1,400. (completion 1998)
Do.		Suez Cement Co. (Government, 60%; private interests, 40%)	Ain Sukhna Qattamia Waddi Hagoul	1,700. 1,200. 1,200.
Do.		Alexandria Portland Cement Co. (Government 77%; private interests, 23%).	El Mex	800.
Do.		National Cement Co. (Government, 77%; private interests, 23%).	El Tabbin Beni Suef	4,000. 1,000.
Fertilizers, nitrogenous		Société El-Nasr d Engrais et d'Industries Chemiques (Government, 100%)	Abu Qir	660. (ammonia). 760. (ammonia nitrate).
Do.		do.	Suez	146. (ammonia). 450. (nitric acid). 365. (ammonium nitrate).
Do.		do.	Talkha	330. (ammonium nitrate). 570. (ammonia and urea).
Do.		Egyptian Chemical Industries (Government, 100%)	Kimi	330. (ammonia). 600. (nitric acid). 800. (ammonium nitrate).
Ilmenite		El Nasr Phosphate Co. (Government, 100%)	Abu Ghalaga	125.
Iron and steel		Egyptian Iron and Steel Co. (Government, 100%)	Helwan steel plant	1,500.
Do.		Alexandria National Iron and Steel Co. (Government, 64.52%, private, 35.48%)	El Dikheila plant	1,600.
Natural gas	million cubic meters	Egyptian General Petroleum Corp. (EGPC) (Government, 100%)	Badreddin-1, 2 , and 3 Abu Madi Abu Qir/Naf Ras Shukheir	7,000. 5,000. 3,900. 3,700,
Do.	do.	Grupo Khalda (Repsol Exploration S.A., 50%, Apache Oil Co., 40%; Samsung, 10%).	Khalda	95.
Petroleum, crude	million 42-gallon barrels	Gulf of Suez Oil Co. (EGPC, 50%; Amoco, 50%)	October, Suez Gulf El Morgan, Suez Gulf	65. 20.
Do.	do.	Belayim Petroleum Co. (EGPC, 50%; IEOC, 50%)	Belayim, Suez Gulf	62.
Do.		Suez Oil Company (EGPC, 50%; Deminex, 25%; Repsol Exploration S.A.,, 25%)	Ras Budran, Suez Gulf	12.
Do.	do.	Qarun Petroleum Co. (EGPC.50%; Apache Corp., 37.5%, Seagull Energy Corp., 12.5%)	Qarun, Western Desert	15.
Petroleum, pipeline throughtput	million 42-gallon barrels	Arab Petroleum Pipeline Co. (Egypt, 50%; Saudi Arabia, 15%; Kuwait, 15%; United Arab Emirates, 15%; Qatar, 5%)	Ain al-Sokhna to Sidi Kir	875.
Petroleum, refined		Cairo Petroleum Refining Co. (Government, 100%)	Mostorod Tanta	52. 20.
Do.	million 42-gallon barrels	Alexandria Petroleum Co. (Government, 100%)	Alexandria	42.
Do.	do.	El-Nasr Petroleum Refining Co. (Government, 100%)	Suez	36.
Do.	do.	Ameriya Petroleum Refining Co. (Government, 100%	Ameriya	27.
Do.	do.	Suez Petroleum Processing Co. (Government, 100%)	Suez	25.
Do.	do.	Ameriya Lubricant Oil Blending Co. (Government, 100%)	Ameriya	1.
Do.	do.	Asyut Petroleum Refining Co. (Government, 100%)	Asyut	18.

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TABLE 2--Continued
EGYPT: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilites	Annual capacity
Phosphate rock		Egyptian Organization of Industrial and Mining Complexes (Government, 100%)	Abu Tartur	2,200.
Salt:				
Sodium sulfate	million 42-gallon barrels	Egyptian Salts & Minerals Co. (EMISAL)	Lake Quarun	96.
Sodium chloride	do.	do.	do.	200.
Magnesium oxide	do.	do.	do.	20.

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TABLE 3
EGYPT: EXPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity	Total	Destinations: United States	Destinations: Other (principal)
METALS			
Aluminum:			
Oxides and hydroxides	400	--	All to Italy.
Metal including alloys:			
Scrap	127	--	All to Netherlands.
Unwrought	96,880	--	Netherlands 46,327; Greece 10,568; Italy 6,606.
Semimanufactures	10,488	86	Jordan 2,507; Greece 2,182; Syria 1,356.
Copper, metal including alloys:			
Scrap	124	--	Italy 76; Republic of Korea 48.
Semimanufactures	665	1	Syria 223; Republic of Korea 137; Germany 62..
Gold, metal including alloys, unwrought and partly wrought kilograms	1	--	All to United Arab Emirates.
Iron and steel, metal:			
Scrap	1,719	--	Netherlands 1,296; Republic of Korea 136; United Kingdom 106.
Ferroalloys:			
Ferromanganese	1,153	--	Syria 519; Libya 336; Turkey 298.
Ferrosilicon	31,745	13,819	Netherlands 7,390; United Kingdom 3,751; Germany 3,026.
Silicon metal 2/	926	926	
Steel, primary forms	2	--	All to Saudi Arabia.
Semimanufactures:			
Flat-rolled products:			
Of iron or nonalloy steel:			
Not clad, plated, coated	62	--	Jordan 49; Germany 13.
Clad, plated, coated	1,217	--	Saudi Arabia 1,179; Jordan 25; Sudan 7.
Of alloy steel	1,151	--	Spain 1,076; Netherlands 75.
Bars, rods, angles, shapes, sections	73,382	--	Saudi Arabia 42,149; Syria 7,573; Spain 5,515.
Rails and accessories	76	--	All to Saudi Arabia.
Wire	44,335	8,126	Saudi Arabia 18,679; Tunisia 8,962; Netherlands 4,811.
Tubes, pipes, fittings	12,294	2,846	Cyprus 5,917; Italy 1,187; Syria 793.
Lead, metal including alloys, scrap	14	--	All to Belgium-Luxembourg.
Magnesium, metal including alloys, scrap	13	--	Germany 7; United Kingdom 6.
Manganese, ore and concentrate, metallurgical-grade	40	--	All to Italy.
Nickel, metal including alloys, semimanufactures value, thousands	$1	--	All to Kuwait.
Silver, metal including alloys, unwrought and partly wrought do.	$9	$9	
Tin, metal including alloys, unwrought	195	--	Sudan 155; Ethiopia 40.
Zinc:			
Ore and concentrate	80	--	All to Belgium-Luxembourg.
Blue powder 3/	411	--	Do.
Other, ashes and residues	232	--	Do.
INDUSTRIAL MINERALS			
Abrasives, n.e.s., grinding and polishing wheels and stones	108	--	South Africa 54; Italy 25; Lebanon 20.
Cement	44,952	--	Unspecified Asia 38,042; Israel 4,300; Saudi Arabia 2,610.
Chalk	21	--	All to Sudan.
Clays, crude:			
Bentonite	2,017	--	Libya 1,000; Israel 966; Lebanon 36.
Kaolin	3,250	--	United Arab Emirates 2,995; Greece 60; Jordan 44.
Unspecified	3,079	--	Libya 2,069; Israel 560; Japan 250.
Cryolite and chiolite	4,438	--	Netherlands 3,425; Russia 1,013.
Diamond, natural, gem, not set or strung value, thousands	$5	--	All to Oman.
Feldspar	4	--	All to Italy.
Fertilizer materials, manufactured:			
Ammonia	15,548	--	Italy 14,048; Morocco 1,500.
Nitrogenous	36,515	--	Sudan 10,853; Greece 7,344; Italy 6,765.
Phosphatic	45,791	--	Sudan 14,415; Sri Lanka 12,250; Burma (Myanmar) 12,232.
Potassic	20	--	All to Saudi Arabia.
Unspecified and mixed	4,960	--	All to Italy.
Fluorspar	60	--	All to Saudi Arabia.
Graphite, natural	166	--	Israel 26; Saudi Arabia 26; free zones 100.
Gypsum and plaster	398,990	--	Japan 385,865; United Arab Emirates 5,323; Jordan 1,481.

See footnotes at end of table.

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TABLE 3--Continued
EGYPT: EXPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Destinations: United States	Destinations: Other (principal)
INDUSTRIAL MINERALS--Continued				
Lime		598	--	Saudi Arabia 500; free zones 98.
Phosphates, crude		1,150	--	All to Saudi Arabia.
Pigments, mineral, iron oxides and hydroxides, processed		22	--	All to Jordan.
Salt and brine		298,527	183,140	Croatia 43,036; Italy 27,400; Slovenia 21,057.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		2,233	--	Saudi Arabia 2,000; Sudan 200; Jordan 22.
Sulfate, manufactured		38,945	--	Saudi Arabia 17,165; Syria 8,233; Jordan 6,365.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		24,332	249	Italy 10,918; Saudi Arabia 2,897; Indonesia 1,931.
Worked		1,262	125	Italy 475; Singapore 180; Israel 179.
Dolomite, chiefly refractory-grade		1	--	All to Saudi Arabia.
Gravel and crushed rock		9,783	--	Israel 9,746; Jordan 36; Saudi Arabia 2.
Sand other than metal-bearing		282,057	--	Turkey 115,597; Italy 108,437; Greece 47,700.
Sulfur:				
Elemental:				
Crude including native and byproduct		1,260	--	All to Cyprus.
Colloidal, precipitated, sublimed		82	--	Do.
Sulfuric acid		2,325	--	Libya 1,550; Sudan 775.
Talc, steatite, soapstone, pyrophyllite		4,610	--	Germany 2,000; Spain 1,460; Greece 280.
Other:				
Crude		201	--	Syria 101; Israel 100.
Slag and dross, not metal-bearing		32	--	All to United Kingdom.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		1,981	--	Saudi Arabia 1,668; United Arab Emirates 228; Bahrain 85.
Carbon, black		21,722	524	Israel 4,795; Greece 2,863; Italy 2,588.
Coal:				
Anthracite		311		All to Japan.
Briquets of anthracite and bituminous coal		2	--	All to Saudi Arabia.
Coke and semicoke		394,403	--	Tunisia 105,996; Germany 64,390; France 61,445.
Petroleum:				
Crude	thousand tons	6,685	1,723	Israel 2,628; Italy 501; Greece 302.
Refinery products:				
Mineral jelly and wax		40,390	565	Germany 37,213; United Kingdom 515; Belgium-Luxembourg 476.
Unspecified petroleum products	thousand tons	5,964	168	Italy 1,886; Netherlands 1,441; Singapore 442.

1/ Table prepared by Glenn J. Wallace.
2/ May include high-purity silicon.
3/ Includes zinc dust, flakes, and powders.

Source: United Nations Statistical Office (microfiche).

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TABLE 4
EGYPT: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals		13	11	Italy 2.
Alkaline-earth metals		21	20	Italy 1.
Aluminum:				
Ore and concentrate		400,670	141	Australia 374,508; Italy 6,992; Jordan 5,611.
Oxides and hydroxides		3,805	66	France 2,304; Netherlands 550; China 400.
Metal including alloys:				
Scrap		135	--	Belarus 96; Ethiopia 28.
Unwrought		2,645	--	Netherlands 1,828; Russia 799; Italy 15.
Semimanufactures		7,184	1,111	Italy 2,236; Germany 1,243; France 597.
Antimony, metal including alloys, all forms		35	--	All from China.
Cadmium, metal including alloys, all forms	value, thousands	$2	$2	
Chromium:				
Ore and concentrate		20	--	All from Netherlands.
Oxides and hydroxides		19	--	Russia 17; Germany 2.
Cobalt, oxides and hydroxides		23	(2/)	Belgium-Luxembourg 16; Spain 5; Nigeria 1.
Copper, metal including alloys:				
Scrap		276	--	Belarus 121; Belgium-Luxembourg 40; Germany 38.
Unwrought		94	--	Italy 51; Libya 22; Germany 18.
Semimanufactures		23,862	2,225	Saudi Arabia 13,884; Germany 2,109; Poland 1,017.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite		881,265	--	Brazil 545,236; Norway 137,500; Sweden 137,500.
Metal:				
Scrap		121,382	250	United Kingdom 31,676; Ukraine 29,021; Germany 20,409.
Pig iron, cast iron, related materials		270,793	172	India 105,174; Switzerland 35,964; United Kingdom 30,157.
Ferroalloys:				
Ferrochromium		244	--	China 112; Netherlands 60; Germany 12.
Ferromanganese		14,203	19	France 2,502; Germany 2,014; Spain 210.
Ferrosilicochromium		7	--	All from Sweden.
Ferrosilicomanganese		9,495	--	Turkey 4,564; Ukraine 3,130; China 1,209.
Ferrosilicon		1,717	558	Germany 630; Norway 365; South Africa 63.
Silicon metal 3/		10	--	India 3; United Kingdom 3; unspecified Asia 4.
Unspecified		126	--	Sweden 44; South Africa 35; Japan 21.
Steel, primary forms		642,561	1,968	Russia 519,273; Ukraine 57,394; Portugal 16,588.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		441,381	8,159	Russia 135,376; Ukraine 91,051; Libya 61,563.
Clad, plated, coated		155,228	4,097	Russia 29,680; Italy 20,503; Germany 20,174.
Of alloy steel		27,038	299	France 5,281; Germany 5,275; Turkey 4,660.
Bars, rods, angles, shapes, sections		971,470	7,814	Saudi Arabia 244,217; Libya 149,516; Turkey 139,338.
Rails and accessories		9,030	--	Poland 5,396; Czech Republic 2,991; Switzerland 529.
Wire		8,390	93	United Kingdom 2,582; Belgium-Luxembourg 1,233; Turkey 1,175
Tubes, pipes, fittings		106,365	14,376	China 32,065; Italy 8,373; Germany 6,698.
Lead:				
Ore and concentrate		35	--	All from Morocco.
Oxides		1,180	--	Italy 433; Spain 325; Bulgaria 110.
Metal including alloys:				
Scrap		243	--	Jordan 220; Sudan 22; Japan 1.
Unwrought		8,318	--	Greece 3,572; Bulgaria 2,157; Switzerland 1,914.
Semimanufactures		65	--	Belgium-Luxembourg 26; Malaysia 13; France 11.
Magnesium, metal including alloys:				
Unwrought		71	--	Switzerland 20; Republic of Korea 20; United Kingdom 19.
Semimanufactures		18	1	United Kingdom 14; Germany 1; Italy 1.
Manganese:				
Ore and concentrate, metallurgical-grade		12,617	--	Australia 4,326; Brazil 3,828; Central African Republic 3,240.
Oxides		2,102	7	Germany 1,444; Hong Kong 182; Belgium-Luxembourg 153.

See footnotes at end of table.

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TABLE 4--Continued
EGYPT: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS--Continued				
Mercury		28	5	Russia 15; Netherlands 7; Germany 1.
Molybdenum, metal including alloys, semimanufactures	value, thousands	$47	$15	Netherlands $17; Spain $14.
Nickel:				
Matte and speiss		21	--	All from United Kingdom.
Metal including alloys:				
Unwrought		200	--	United Kingdom 50; Finland 45; Canada 27.
Semimanufactures		22	--	United Kingdom 15; Italy 3; Canada 2.
Silver, metal including alloys, unwrought and partly wrought	value, thousands	$4,858	--	Switzerland $4,259; United Kingdom $353; Germany $220.
Tin, metal including alloys:				
Unwrought		4,025	22	Russia 1,000; Romania 414; Turkey 381.
Semimanufactures		40	--	Italy 14; Republic of Korea 14; Israel 10.
Titanium:				
Ore and concentrate		1,423	--	Sri Lanka 251; Ukraine 244; Turkey 220.
Oxides		1,023	84	France 456; Germany 322; Finland 51.
Metal including alloys:				
Unwrought		14	--	All from Belgium-Luxembourg.
Semimanufactures		80	(2/)	Mainly from United Kingdom.
Tungsten, metal including alloys, semimanufactures		9	(2/)	Netherlands 7; Japan 1.
Uranium and thorium:				
Ore and concentrate	value, thousands	$112	--	All from Turkey.
Metal including al oys:				f
Uranium	do.	$70	$17	Switzerland $30; Russia $9; United Kingdom $4.
Thorium	do.	$23	--	All from Italy.
Vanadium, metal including alloys, all forms		31	--	All from South Africa.
Zinc:				
Oxides		1,366	7	China 924; Turkey 117; France 84.
Metal including alloys:				
Scrap		20	--	All from Saudi Arabia.
Unwrought		9,058	--	Bulgaria 3,798; United Kingdom 1,083; Kazakstan 1,032.
Semimanufactures 4/		303	--	Germany 147; China 91; Italy 25.
Zirconium, ore and concentrate		245	--	All from Germany.
Other:				
Oxides and hydroxides		46	8	France 34; Italy 10; Japan 2.
Ashes and residues		55	--	Kuwait 35; Jordan 20.
Base metals including alloys, all forms		21	--	All from South Africa.
Metalloids		57	--	India 44; Belgium-Luxembourg 9; Germany 2.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc.		271	--	Turkey 86; Germany 53; France 51.
Artificial corundum		39	--	Germany 21; Italy 18.
Dust and powder of precious and semiprecious stones	value, thousands	$58	--	Germany $37; France $12; United Kingdom $8.
Grinding and polishing wheels and stones		5,677	24	Italy 3,420; Slovenia 699; Japan 438.
Asbestos, crude		29,849	193	Greece 11,180; Canada 3,456; Switzerland 1,041.
Barite and witherite		354	82	United Kingdom 188; Germany 17; Italy 7.
Boron, oxides and acids		403	--	Turkey 250; Italy 72; Germany 40.
Bromine, fluorine, iodine		321	4	Switzerland 230; Germany 44; United Kingdom 29.
Cement	thousand tons	2,276	13	Romania 911; Greece 713; Russia 335.
Chalk		58	--	Italy 41; Japan 17.
Clays, crude:				
Bentonite		2,535	362	India 1,503; United Kingdom 584; Spain 44.
Kaolin		55,829	78	United Kingdom 40,877; Turkey 6,065; Japan 5,548.
Unspecified		1,520	787	United Kingdom 356; Germany 346; Spain 22.
Cryolite and chiolite		305	--	Finland 269; Spain 36.
Diatomite and other infusorial earth		487	270	Spain 107; Germany 60; Belgium-Luxembourg 28.
Feldspar		23,149	--	Turkey 21,609; Italy 704; Netherlands 566.

See footnotes at end of table.

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TABLE 4--Continued
EGYPT: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
INDUSTRIAL MINERALS--Continued				
Fertilizer materials:				
Crude, n.e.s.		428	9	Israel 410; Sri Lanka 9.
Manufactured:				
Ammonia		6	--	Mainly from Germany.
Nitrogenous	value, thousands	$2	--	All from Italy.
Phosphatic		41	--	Mainly from Jordan.
Potassic		38,560	329	Germany 12,005; Switzerland 5,500; France 5,361.
Unspecified and mixed		13,854	999	Israel 5,200; Belgium-Luxembourg 3,833; United Kingdom 1,895.
Fluorspar		1,654	21	Turkey 1,550; Germany 39; Switzerland 22.
Graphite, natural		912	--	China 899; Germany 13.
Gypsum and plaster		3,353	89	Turkey 2,372; Germany 551; Italy 299.
Lime		1	--	All from United Kingdom.
Magnesium compounds:				
Magnesite, crude		1,993	--	Turkey 1,103; China 525; Austria 154.
Oxides and hydroxides		25,781	830	Austria 6,403; Turkey 6,126; Japan 4,815.
Mica:				
Crude including splittings and waste		131	20	India 101; United Kingdom 10.
Worked including agglomerated splittings		7	--	China 3; Belgium-Luxembourg 1; Germany 1.
Nitrates, crude		81	--	All from Netherlands.
Phosphates, crude		26,800	--	Jordan 20,500; Syria 6,300.
Pigments, mineral, iron oxides and hydroxides, processed		3,565	--	China 2,441; Italy 385; Hong Kong 329.
Precious and semiprecious stones other than diamond:				
Natural	value, thousands	$112	$4	Indonesia $64; Hong Kong $20; Pakistan $14.
Synthetic	do.	$178	$46	Republic of Korea $48; China $28; Pakistan $20.
Salt and brine		1,767	20	Netherlands 1,431; Germany 55; Saudi Arabia 54.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		32,730	816	Romania 12,635; Bulgaria 9,957; Turkey 4,878.
Sulfate, manufactured		59	--	China 50; Belgium-Luxembourg 4; India 2.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		41,893	--	Italy 31,105; Spain 7,926; Greece 592.
Worked		5,390	--	Italy 2,772; Greece 1,093; Germany 253.
Dolomite, chiefly refractory-grade		45	--	Norway 22; France 21; United Kingdom 2.
Gravel and crushed rock		158	19	Italy 82; Israel 36; Germany 20.
Limestone other than dimension		18	18	
Quartz and quartzite		359	(2/)	Sweden 175; Germany 104; Italy 45.
Sand other than metal-bearing		2,213	20	Germany 725; Denmark 459; Italy 221.
Sulfur:				
Elemental:				
Crude including native and byproduct		322,139	--	Iran 76,157; Germany 58,774; Switzerland 35,298.
Colloidal, precipitated, sublimed		541	--	All from Germany.
Dioxide		1	--	All from Netherlands.
Sulfuric acid		13	--	France 8; Sweden 2; Germany 1.
Talc, steatite, soapstone, pyrophyllite		1,125	7	Italy 435; France 193; Belgium-Luxembourg 104.
Vermiculite, perlite, chlorite		120	--	Greece 100; Germany 20.
Other:				
Crude		3,182	--	Italy 1,355; Germany 605; Sudan 582.
Slag and dross, not metal-bearing		188	--	Germany 168; Japan 20.
MINERAL FUELS AND RELATED MATERIALS				
Carbon, black		2,809	7	Italy 1,471; United Kingdom 759; Germany 234.
Coal:				
Anthracite		773	--	United Kingdom 679; Italy 53; Australia 29.
Other	thousand tons	1,875	1,039	Australia 493; Poland 205; Canada 93.
Coke and semicoke		5,117	53	Norway 4,896; Italy 48; Belgium-Luxembourg 41.
Peat including briquets and litter		9,356	66	Ireland 5,743; Germany 2,675; United Kingdom 575.

See footnotes at end of table.

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TABLE 4--Continued
EGYPT: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity	Total	Sources	
		United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS--Continued			
Petroleum refinery products:			
Liquefied petroleum gas	6,992	--	Greece 3,988; Libya 3,004.
Mineral jelly and wax	2,844	6	United Kingdom 1,019; Hungary 763; Germany 447.
Bitumen and other residues	107,882	--	Kuwait 81,173; Morocco 26, 669; Italy 40.
Bituminous mixtures	432	11	Saudi Arabia 294; France 98; Netherlands 26.
Petroleum coke	2,950	--	Turkey 1,917; Greece 527; India 260.
Unspecified petroleum products	181,409	4,984	Israel 55,160; Italy 43,602; Greece 36,526.

1/ Table prepared by Glenn J. Wallace.
2/ Less than 1/2 unit.
3/ May include high-purity silicon.
4/ Includes zinc dust, powders, and flakes.

Source: United Nations Statistical Office (microfiche).

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THE MINERAL INDUSTRY OF

GABON

By George J. Coakley

The equatorial African nation of Gabon has an area of 257,670 square kilometers and supported a population of about 1.2 million in 1997, with a gross domestic product (GDP) per capita of $5,000 based on 1996 purchasing power parity data. The mineral industry was dominated by crude petroleum production, which accounted for about 60% of Government revenues and more than 40% of GDP. Petroleum was produced by three companies, in order of decreasing output—Shell Gabon of the Netherlands, Elf Gabon of France, and Perenco Plc. of the United Kingdom. Although Gabon withdrew its membership in the Organisation of Petroleum Exporting Countries in 1996, its petroleum production remained level at around 362,000 barrels per day in 1997.

On the mining side, the country was an important world source of manganese and uranium ore. The uranium mine at Mounana in Haut Ogooué Province was, however, nearing depletion, and Compagnie des Mines d'Uranium de Franceville planned to close it in 1999. During 1997, the Eramet Group of France increased its ownership in Compagnie Minière de l'Ogooué S.A. (Comilog) to more than 50% and took over management and operating control of Comilog's manganese mine near Franceville. Several junior exploration companies were exploring for gold, and the Government-owned (62%) Société Minière du Moyen Ogooué consortium was actively seeking investors to develop phosphate from the Mabounié carbonatite complex near Lambaréné in the west-central portion of the country. For more extensive coverage of the minerals industry of Gabon, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE I
GABON: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Cement:						
Clinker		132,398	124,600 r	132,398 r/	162,000 r/	176,000
Cement, hydraulic 3/		141,283	147,798 r	153,953 r/	180,000 r/	200,000
Diamond, gem and industrial e/	carats	500	500	500	500	500
Gas, natural, gross	million cubic meters	153	129	150	100 r/	99
Gold, mine output, Au content e/ 4/	kilograms	120	72	70	70	70
Manganese:						
Metallurgical-grade ore, gross weight (50% to 53% Mn) 5/		1,257,000	1,366,000 e	1,844,000	1,933,000	1,860,000
Pellets, battery- and chemical-grade, gross weight (82% to 85% MnO_2)		33,000	70,000 e	86,000	50,000	44,000
Total 5/		1,290,000	1,436,000	1,930,000	1,983,000	1,904,000 6/
Petroleum:						
Crude	thousand 42-gallon barrels	114,000	126,000	133,000	134,000	134,000
Refinery products	do.	5,800	6,900	5,466 r/	6,043 r/	6,315 6/
Uranium, content of concentrate		592	589	653	623	472 6/

e/ Estimated. r/ Revised.

1/ Table includes data available through July 2, 1999.

2/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

3/ Includes cement produced from imported clinker.

4/ Gold production figures do not include production smuggled out of the country, which in recent years was estimated to exceed 400 kilograms per year.

5/ Data are rounded to four significant digits.

6/ Reported figure.

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THE MINERAL INDUSTRY OF

THE GAMBIA

By Philip M. Mobbs

The Gambian economy was dominated by agriculture and tourism; there was no significant mineral industry. The Government reported production of clays for bricks, laterite, sand and gravel, silica sand, and shells, primarily for domestic construction needs. For more extensive coverage of the mineral industry of The Gambia, see the 1992 Minerals Yearbook, Volume III, Mineral Industries of Africa.

TABLE 1
THE GAMBIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons)

Commodity	1993	1994	1995	1996	1997
Clay	1,000	1,000	1,000	1,000	1,200 3/
Silica sand	400,000	450,000	450,000	452,400 3/	302,600 3/

1/ Includes data available through August 14, 1998.
2/ In addition to the commodities listed, a variety of construction materials (laterite, sand, and shell) are produced; but information is inadequate to make estimates of output.
3/ Reported figure.

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THE MINERAL INDUSTRY OF

GHANA

By George J. Coakley

Ghana is a West African country with an area of 238,540 square kilometers, 18 million people, and a per-capita gross domestic product based on purchasing power parity of about $2,000.[1] The economy is led, in order of export revenue importance, by cocoa, gold, and timber production. Ghana was the second-largest gold producer in Africa, after South Africa. It also was the third-largest African producer of aluminum metal and manganese ore and a significant producer of bauxite and diamond. (*See table 1.*) In 1997, officially reported output of newly mined gold was 54.4 metric tons with a market value of about $545 million. Aluminum exports were valued at $258 million, less the value of alumina and other raw material imports used in its production. Diamond production was valued at $16 million; bauxite, at $10.5 million; and manganese ore, at $8.8 million. Ashanti Goldfields Company Ltd. accounted for about 60% of the gold production. (*See table 2.*) During 1997, Ranger Minerals NL of Australia's Damang Mine (December startup with no 1997 production reported) and Resolute Ltd. of Australia's Obotan gold mines were brought into production, with Ashanti's Bibiani Mine, Gold Fields (Ghana) Ltd. of South Africa's major new Tarkwa open pit, and Glencar Explorations Plc. of Ireland's Wassa Mine scheduled to startup in 1998. The largest of these, the $125 million Tarkwa open pit, heap leach project, which involved the relocation of 20,000 Ghanaian villagers, will produce 15,500 kilograms per year of gold by 2000 from a resource of over 404,000 kilograms.

After a 5-year decline in production, the Ghana Manganese Company Ltd. significantly increased output from its Nsuta Mine in 1996 and 1997 as it shifted from mining manganese oxide to mining the deeper manganese carbonate ores. Power supply problems continued to beleaguer the Volta Aluminum Company Ltd.'s aluminum smelter, owned by Kaiser Aluminum Corp. of the United States. The smelter operated at 70% of capacity in 1997 and was expected to drop to 20% of capacity in 1998. In early 1998, Alcan Aluminium Ltd. of Canada increased its equity share in Ghana Bauxite Company Ltd. from 45% to 80% and planned to expand capacity at the Awaso bauxite mine in the Western Region to 1 million metric tons per year.

Declining annual rainfall levels, combined with a steady surge in load requirements, has exerted pressure on Ghana's hydroelectric power generation capacity and is serving as a constraint on new industrial development. In response, the Ghana National Petroleum Corporation (GNPC), in cooperation with Chevron Overseas Petroleum Inc., have initiated plans to build a West African gas pipeline that would supply Benin, Ghana, and Togo with Nigerian natural gas. Plans call for doubling Ghana's power generating capacity to 2,600 megawatts by 2001, through the construction of several new gas-fueled powerplants. Until the gas pipeline is built, natural gas can be supplied from GNPC's offshore Tano gasfield. For more extensive coverage of the mineral industry of Ghana, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

Major Sources of Information

Geological Survey Department
P.O. Box M 80
Accra, Ghana
Telephone: 233-21-228-093 or 226-490
Minerals Commission
P.O. Box M 248
Accra, Ghana
Telephone: 233-21-772-783/772-786
Fax: 233-21-773-324
Mines Department
P.O. Box 3634
Accra, Ghana
Telephone: 233-21-77-536/776-802
Fax: 233-31-24-344 (Takoradi office)
Ghana Chamber of Mines
P.O. Box 991
Accra, Ghana
Telephone: 233-12-760-652 or 761-893
Fax: 233-12-760-653

[1]Where necessary, values for 1997 have been converted from Ghanaian cedis © to U.S. dollars at the rate of C2,050=US$1.00.

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TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Aluminum:						
Bauxite, gross weight		424 r/	426 r/	513 r/	473 r/	504 3/
Metal, smelter, primary		175	141	135	137	152 3/
Arsenic, trioxide 4/	metric tons	902	3,897	4,409	5,443	5,500
Cement, hydraulic 5/		1,200	1,350	1,300 e/	1,300 e/	1,400
Diamond:						
Gem e/	thousand carats	473	592	506	572	664
Industrial e/	do.	118	148	126	143	166
Total 6/	do.	591	740	632	715	830 3/
Gold 7/	kilograms	38,911	43,478	53,087	49,211	54,662 3/
Manganese:						
Ore, processed		295 e/	265	217	448 r/	437 3/
Mn content e/		115	101	82 r/	152 r/	140
Petroleum:						
Crude 7/	thousand 42-gallon barrels	--	--	--	2,600	2,600
Refinery products:						
Liquefied petroleum gas	do.	40	365	400 e/	400 e/	400
Gasoline	do.	325	1,825	1,900 e/	1,900 e/	1,900
Jet fuel	do.	100	365	400 e/	400 e/	400
Kerosene	do.	200	1,095	2,000 e/	2,000 e/	2,000
Distillate fuel oil e/	do.	400	1,460 3/	1,500	1,500	1,500
Residual fuel oil	do.	475	2,190	2,200 e/	2,200 e/	2,200
Other including refinery fuel and losses e/	do.	210	365	400	400	400
Total	do.	1,750 8/	7,665	8,800 e/	8,800 e/	8,800
Salt e/		50	50	50	50	50
Silver, content of gold ore e/	kilograms	1,960	2,230	2,660	2,450	3,200
Steel, crude e/		25	25	25	25	25

e/ Estimated. r/ Revised.
1/ Table includes data available through June 23, 1999.
2/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) were produced, as was limestone for processing of some gold ore. Output of these commodities is not reported and information is inadequate to make reliable estimates of output levels.
3/ Reported figure.
4/ Reported data from Ashanti Goldfields. Bogosu roaster capable of producing arsenic before closing in 1996.
5/ All from imported clinker.
6/ Production, in thousand carats, includes that of Akwatia Mine [1993--214; 1994--356; 1995--294; 1996--271; and 1997--300 (estimated)], and PMMC purchases of artisanal production [1993--376; 1994--406; 1995--337; 1996--443; and 1997--400 (estimated)]. Estimates of unreported artisanal productionare not included.
7/ Does not include estimate of smuggled production.
8/ Refinery was reported closed for maintenance for much of the year.

TABLE 2
GHANA: GOLD PRODUCTION BY COMPANY AND MINE

(Kilograms)

Company	Mine	1993	1994	1995	1996	1997
Amansie Resources (Resolute Ltd.)	Obotan, open pit	--	--	--	--	2,151
Ashanti Goldfields Company Ltd.	Ayanfuri, open pit 1/	--	139	1,744	1,717	1,807
Do.	Iduapriem, open pit 2/	3,835	3,689	3,866	3,669	4,560
Do.	Obuasi Complex, open pit and underground	23,831	26,548	29,138	26,761	26,687
Barnex (Prestea) Ltd.	Prestea, underground 3/	654	612	840	1,062	1,011
Billiton Bogosu Gold Ltd.	Bogosu, open pit	2,784	3,402	3,349	3,327	3,464
Bonte Gold Mines Ltd.	Esaase, placer	227	508	567	668	879
Dunkwa Continental Goldfields Ltd.	Dunkwa, placer 4/	122	97	104	173	118
Gold Fields (Ghana) Ltd.	Tarkwa, underground 5/	1,221	1,224	1,382	1,476	1,672
Obenemasi Gold Mines Ltd.	Konongo/Obenemasi, open pit	--	--	690	588	176
Precious Minerals Marketing Corp.	Artisanal workings 6/	1,107	1,772	3,898	2,913	3,331
Prestea Sankofa Gold Ltd.	Prestea, tailings 7/	--	--	184	540	626
Teberebie Goldfields Ltd.	Teberebie, open pit	5,129	5,487	7,325	6,317	8,180
Total		38,911 8/	43,478	53,087	49,211	54,662

1/ Acquired in purchase of Cluff Resources in 1996; 1,659 kilograms attributed to Ashanti in 1996.
2/ Acquired in merger with Golden Shamrock in 1996; 590 kilograms attributed to Ashanti in 1996.
3/ Acquired from SGMC in 1996.
4/ Acquired from SGMC in 1995.
5/ Acquired from SGMC in 1993.
6/ Includes 8 to 110 kilograms per year byproduct gold from Ghana Consolidated Diamonds Ltd.'s Akwatia Mine.
7/ Acquired from SGMC in 1994.
8/ Data do not add to total shown due to independent rounding.

Source: Ghana Minerals Commission

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THE MINERAL INDUSTRY OF

GUINEA

By Philip M. Mobbs

Guinea was the world's second largest bauxite producer and had the world's largest bauxite resources (Plunkert, 1998). In 1997, mining accounted for about 16% of the nation's estimated $3.9 billion gross domestic product, 89% of Government revenue, and more than 80% of Guinea's exports.[1] The limited domestic demand for crude minerals resulted in the mineral sector effectively dominating the nation's exports. In 1997, the country's total exports were valued at $770 million compared with $696 million in 1996 (U.S. Department of State, June 1998, Country commercial guide, accessed on November 9, 1998, at URL http://www.eti-bull.net/USEMBASSY/cc99h.htm). In 1996, the latest year for which data are available, bauxite accounted for 45% of value of national exports; gold, 15%; alumina, 14%; and diamond, 7%.

Guinea supplied 39% of the United States' metallurgical-grade bauxite imports in 1997. Less than 10% of mined bauxite was used to produce alumina in Guinea.

The Government encouraged infrastructure development and promoted mineral industry expansion. The Mining Code of 1995 defined incentives, mineral ownership, mining fees, mining titles, royalties, and other taxes. The Government reserved 15% free equity in gold and gem operations. State participation in bauxite- and iron-ore-mining ventures was subject to negotiation. Mineral beneficiation in Guinea was encouraged. Under the new law, the royalties were 5% on alumina and 3.5% on concentrates compared with 10% on bauxite and 7% on other ores. The corporate income tax rate was 35%.

In addition to possessing significant bauxite reserves, Guinea had diamond, gold, granite, and iron deposits. The Government encouraged the expansion of the bauxite sector and promoted the diversification of the mineral industry, indicating that chromium, cobalt, graphite, limestone, manganese, nickel, tin, and uranium resources also existed in the country but need additional investigation (Ministère des Mines et de la Géologie, 1995).

The Government initiated a mineral industry privatization program. In November, the investment bank SBC Warburg Dillon Read was appointed to advise the Government on the possibility of restructuring the bauxite industry, which was dominated by three companies. The almost 14-million-metric-ton-per-year (Mt/yr)-capacity Compagnie des Bauxites de Guinée (CBG) operated a number of open-pit bauxite mines in the Boké District, including the Sangarédi Mine. Halco Mining Inc. (51%) and the Government (49%) controlled CBG. The state-owned Société des Bauxites de Kindia (SBK) was restoring production to the operation's nominal 3-Mt/yr capacity. SBK's production was exported to the Ukraine. In December, SBC Warburg Dillon Read was asked to intercede in the dispute between the Government and the Frialco Holding Co. concerning the Société d'Economie Mixte Friguia. Friguia, owned by the Frialco Holding Co. (51%) and the Government (49%), operated the Fria bauxite mine and the Kimbo alumina refinery. Halco and Frialco were consortia of international aluminum companies.

The dissension between the Government of Guinea and Frialco escalated in April 1997 after a failure to renew the Friguia management contract. The Government subsequently declared Friguia bankrupt. Because the State wanted more value-added alumina production rather than raw bauxite exports, it claimed that the Frialco consortium was not making adequate investments in the alumina sector and that the integration of Friguia's alumina production with the Frialco partner's international interests limited the plant's incentives and local accountability. Frialco reportedly was concerned that Friguia had been losing money in recent years, that the Government's social agenda conflicted with efficient plant management, and that the State's 1995 agreement to privatize the company had not been carried out. Frialco filed for arbitration (Financial Times, 1997; Metal Bulletin, 1997; Mining Journal, 1998a).

At yearend, Union Mining NL of Australia obtained a reconnaissance licence for the Gaoual bauxite deposits in northwestern Guinea. Previous exploration work had indicated the presence of nine bauxite deposits in the concession area. The company suggested that bauxite resources were 1.16 billion metric tons at an average grade of 52.7% Al_2O_3 (Union Mining NL, 1998, Quarterly report—For the period ended 31 March 1998, accessed July 9, 1998, at URL http://www.unionmining.com.au/March98 quarter.html). The Government was encouraging development of the Dabola and the Dian-Dian projects. Itok Guinea, a subsidiary of Iran Itok Engineering and Technological Co. of Iran, was evaluating the feasibility of a 600,000-metric-ton-per-year bauxite mining operation and a 1.2-Mt/yr alumina refinery at Dabola. The Dian-Dian proposal included a 11-Mt/yr bauxite mine and an aluminum smelter.

In southeast Guinea, the Nimba Mountain iron ore project of Nimba International Mining Co. (NIMCO) was again being restructured. NIMCO was evaluating options for transporting ore to ports on the Atlantic Coast. To the north of the Nimba Mountains, Rio Tinto plc of the United Kingdom began exploration of the banded-iron deposits in the Simandou Range.

Artisanal operators were significant gold producers, accounting for about 80% of the national gold output (European Union, 1998, Mines '98—Guinea, accessed August 25, 1998, at URL http://www.landscape.de/mines98/country/gn/index.htm). Société Minière de Dinguiraye (SMD) operated the open pit Léro gold

[1]Where necessary, values have been converted from Guinean francs (GnF) to U.S. dollars at the average exchange rate of GnF1,077=US$1.00.

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mine. SMD was owned by the Government (15%) and Delta Gold Mining (85%), a Jersey registered corporation of the United Kingdom. Delta, in turn, was owned by Kenor ASA of Norway and Mine Or S.A., the gold operations subsidiary of La Source Group of France. The mine produced 1,502 kilograms (kg) of gold in 1997 compared with 1,207 kg in 1996 (Kenor ASA, Projects, accessed October 28, 1998, at URL http://www.kenor.no/projects/ope_ler.html). Results of exploration in 1997 on the concession allowed SMD to increase the Léro deposit resources by 1.258 Mt grading 3.73 grams per ton (g/t) of gold in 1997. Kenor announced resources of 13 Mt grading 1.52 g/t of gold with a cut-off grade of 0.5 g/t based on a feasibility study of the Fayalala deposit on the Dinguiraye concession, 6 kilometers (km) east of the Léro Mine (Kenor ASA, Projects, accessed October 28, 1998, at URL http://www.kenor.no/projects/dev_fay.html) and was drilling on the Tambico prospect, 2 km northwest of Fayalala.

The $55.7 million Siguri gold prospect was scheduled to start gold production in 1998. At yearend, the Siguri project was owned by the Ashanti Goldfields Co. Ltd. of Ghana (85%) and the Guinean Government (15%). Ashanti had acquired the 15% equity interest formerly held by the International Finance Corp. of the United States. During 1997, the mining contractor, Moolman Brothers of South Africa, mined more than 330,000 metric tons (t) of ore at Siguri. Ores from the Korangbe and the Sanu Tinti pits were crushed, blended, and stacked for heap leaching. The heap leach was designed to handle 4 Mt/yr. Resources at Siguri were estimated to be 67 Mt at an average grade of 1.6 g/t of gold (Mining Journal, 1998b). In addition to construction of the mine and plant, the company upgraded 200 km of road, built a 5.5-megawatt (MW) diesel-fueled electrical generating plant, secured a process water supply for the plant, and developed a potable water supply for the local community.

At the beginning of 1997, Les Minéraux SGV S.A., a subsidiary of Braz-Ouro Resources Inc. of Canada, was exploring the Jean and the Gobele deposits. Resources were estimated by the company to be 2.27 Mt grading 3.07 g/t of gold for the Gobele vein with a cut-off grade of 0.5 g/t and 452,000 t grading 6.17 g/t of gold for the Jean vein (Emerging Africa Gold (EAG) Inc., August 19, 1997, Resource estimates on Jean/Gobele—Guinea, E-mail from portfolio@newswire.ca). Minéraux SGV also was exploring a Simandou area gold prospect. Braz-Ouro was a joint venture of Semafo Inc. of Canada, formerly West Africa Mining Exploration Corporation Inc., and Emerging Africa Gold (EAG) Inc., an affiliated company of St. Geneviève Resources Ltd. In October, Semafo bought EAG's 50% interest in Braz-Ouro. Semafo subsequently dissolved Braz-Ouro and transferred the ownership of Minéraux SGV to Semafo (Barbados) Ltd.

African Selection Mining Corp. of Canada was exploring for gold on the EcoGuinee license in northwestern Guinea while its partner in the joint venture, Eco-Guinea/GUAM S.A.R.L. of Guinea, was working placer deposits on the concession. Africa Selection Mining also held the Labe gold concession. The joint venture of Ashanti and AGEM Ltd., a subsidiary of IAMGOLD Ltd. of Canada, was exploring on the Mandiana and the Kodieran gold concessions. Chalice Mining Inc. of Canada was exploring the Heremakino property after buying out former partner Patrician Gold Mines Ltd. of Canada. EAG explored for gold on the Balandougouba permit and on the Yro-Iran concession before disposing of the properties at yearend as part of the St. Geneviève Resources Group's restructuring and divestment of operations (St. Geneviève Resources Ltd., November 27, 1997, St. Genevieve Resources Ltd. update, accessed December 1, 1997, at URL http://www.newswire.ca/releases/November1997/27/c6868.html). Goldex AS, a wholly owned subsidiary of Kenor, was exploring on the Farabana exploration permit. Golden Limbo Rock Resources S.A., a subsidiary of Mano River Resources Inc. of Switzerland, prospected on the Missimana and the Gueliban gold properties. Pacific Galleon Mining Corp. of Canada was exploring the Bananfara concession. Prospex Mining Inc. of Canada, formerly Akiko Gold Resources Ltd., acquired interest in the Kindia and the Beyla gold concessions from Nearco Jersey (Nominees) Ltd. Reunion Mining plc of the United Kingdom and First Quantum Minerals Ltd. of Canada were evaluating the Nyantanina gold permit.

SAGEM S.A. of Guinea and New Sage Resources Ltd., the Canadian subsidiary of Striker Resources NL of Australia, were exploring the Sankarani gold deposit. Société Minière de Kérouané, a venture of Lithos Corp. of Canada and local partners, was exploring for gold on the Apredor concession. Stirling Management Ltd., a subsidiary of Consolidated African Mining Corp. of the United Kingdom, was exploring on the Kankan South and the Tinkisso South prospects. Prospecting on the Kossaken gold concession was Wells Gold Corp. NL of Australia. Also exploring for gold were Anglo-American Corp. of South Africa, Explorations Minières du Nord Ltd. of Canada, Placer Dome Inc. of Canada, and Semafo Guinée S.A., a subsidiary of Semafo (Barbados) Ltd.

Minéraux SGV was exploring the Kaloum/Mount Kakoulima nickel prospect with AFCAN Mining Corp. of Canada, formerly the Société d'Exploration Pétrolière et Minière Inc.

Increased demand for construction materials contributed to the Government's lifting its restriction on cement imports. Cement imports increased to 65,253 t in 1997 compared with 19,000 t in 1996. Cement clinker imports also increased in 1997.

Nationwide, 70% to 80% of diamond production was of gem quality. More than 80% of production was from indigenous artisanal operations. Aredor FCMC S.A., a venture of First City Mining Co. Ltd. (59.5%), Consolidated African Mining Ltd. of South Africa (25.5%), and the Government of Guinea (15%), produced 14,106 stones weighing 17,014 carats from the Aredor concession in 1997. Aredor FCMC was constructing a 100-metric-ton-per-hour (t/hr) washing plant on its diamond concession to replace the existing test plant. Trivalence Mining Corp. of Canada, the owner of First City Mining, estimated that the Aredor concession's diamond reserves were 1.3 million carats (Northern Miner, 1998). Aredor FCMC also installed a 60-t/hr wash plant to reprocess the more than 10 Mt of tailings generated by the Aredor Mine which had closed in 1994. Aredor FCMC began exploration of the kimberlites on the concession.

Hymex Diamond Corp. of Canada, through its subsidiary, Hymex Guineé S.A., recovered 43,665 stones weighing 24,022 carats from alluvial diamond operations on its Kerouane region concession. On the Diani permit, Hymex installed a 150-cubic-

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Guinea. Jupiter Mining Corp. attempted to sell its two diamond exploration concessions. Failure of the negotiations was attributed to decreased availability of financing for junior mining companies (Global Explorations Corp., January 30, 1998, Form 61 (BC), accessed November 6, 1998, at URL www.sedar.com/dynamic_pages/assoc_docs_e/d00007557.htm). Spider Resources Inc. of Canada, an affiliated company of St. Geneviève Resources Ltd., acquired the rights of its sister company, EAG, to the Apredor diamond permit. Spider also acquired a diamond exploration concession north of Apredor held by Bassad Guinea S.A. Spider released both exploration permits by yearend.

U.S. Oil Corp. of the United States was evaluating the petroleum potential of offshore Guinea.

Total bauxite reserves were estimated at about 20 billion metric tons grading more than 40% aluminum oxide, according to the Ministry of Natural Resources and Energy. Iron resources were estimated to be about 6 billion metric tons grading 64% to 68% iron, and gold reserves were estimated to be between 200 and 1,000 t of contained gold. The Government also estimated there were reserves of 20 million carats of diamond in Guinea (Ministère des Resources Naturelles et de l'Energie, 1997).

Major highways have been paved, but the rural transportation infrastructure was inadequate to meet demand. Guinea had two main ports—Conakry and Kamsar. Conakry, the country's main general cargo port, was linked to the Kinda Mine by a 104-km standard-gauge railroad line and to the Fria Mine by a 145-km, 1-meter (m)-gauge railway. Kamsar, which handled only bauxite shipments, was linked to the Sangarédi Mine by a 135-km standard-gauge railroad line. In addition to the mine railroads, a 661-km 1-m-gauge line connected Conakry with Kankan. The Conakry-Dabola segment of the Conakry-Kankan line was being rehabilitated as part of a $200 million project by Slovak Railways.

Guinea had a nominal installed electricity generating capacity of about 186 MW, of which 134 MW originally could be generated by thermal plants burning imported petroleum fuels and 52 MW was attributed to the Banéa, the Donkéa, the Kinkon, and the Tinkisso hydroelectric powerplants. Many thermal plants and the generators at the Kinkon and the Tinkisso dams operated intermittently, resulting in a tangible generating capacity of about 100 MW in 1997 (Guinéenews, June 1998, Espoirs energétiques en Guinée, accessed November 9, 1998, at URL http://www.myna.com/~boubah/GUINEE/ARCHIVES/9806.htm). Mining companies accounted for about 50% of the thermal power production.

An 11-MW addition to the Tombo thermal plant was nearly complete, and the $237.7-million, 75-MW Garafiri hydroelectric plant was expected to be generating electricity in 1999. Guinea's hydroelectric-power-generating-capacity potential exceeded 6,000 MW. Proposed hydroelectric plants included the 60-MW plant at Kaleta, a plant at Fomi, and the resumption of work on the 750-MW Souapiti project on the Konkoure River. Up to 300 MW of electric power from the Souapiti plant was projected to be dedicated to the proposed Dian-Dian aluminum smelter.

Although the 1995 mining code significantly improved the business climate for the mineral industry, mineral operations remained hampered by infrastructural constraints. International funding of mineral deposit development was proceeding more slowly than anticipated. The less-than-expected foreign investment was attributed to the country's perceived political and economic risks, and decreased availability of financing for junior mining companies, as well as civil disturbances in adjacent Guinea-Bissau, Liberia, Senegal, and Sierra Leone.

Alumina, bauxite, and gold are expected to continue dominating Guinea's economy. The addition of the CBG's Bidikoum Mine should help maintain the high quality of the nation's bauxite exports, and advanced-stage gold-exploration projects enhance the potential input of gold doré into the economy. Ventures requiring significant electric power availability, such as an aluminum smelter, could become feasible as the nation's power-generation capacity is increased.

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TABLE 1
GUINEA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
Alumina:						
Production:						
Hydrate		642	648	630	650	527
Calcined		656	640	616	640	520
Shipments, calcined		656	545	616	619	500
Bauxite:						
Mine production:						
Wet basis 2/		17,100	14,900	18,000	18,700	19,250
Dry basis 3/		15,300	13,300	15,800	16,500	17,100
Calcined		80	89	244	95	100
Shipments (dry basis):						
Metallurgical		13,617	11,033	12,304	13,000 r/ e/	14,500
Calcined		79	91	89	95	95
Diamond 4/ 5/	thousand carats	167	381	365	205	205
Gold 5/	kilograms	3,864	5,617	7,863	6,838	7,000

e/ Estimated. r/ Revised.

1/ In addition to the commodities listed, modest quantities of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported. An estimated 270,000 tons of cement was produced in 1997 from imported clinker. Table includes data available through November 13, 1998.

2/ Metallurgical plus calcinable ore estimated to be 13% water.

3/ Data are for wet-basis ore estimated to be 13% water, reduced to dry basis estimated to be 3% water.

4/ Production is approximately 70% to 80% gem quality.

5/ Figures include artisanal production.

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THE MINERAL INDUSTRY OF

INDIAN OCEAN ISLANDS

By George J. Coakley

Comoros

The Federal Islamic Republic of the Comoros has a total area of 2,170 square kilometers (km^2) and is located on three main islands in the Mozambique Channel about two-thirds of the way between northern Madagascar and northern Mozambique. In 1997, the population was 545,000, and the gross domestic product (GDP) per capita, based on purchasing power parity, was estimated to be $685.

The mineral industry of Comoros continued to be limited to the production of common construction materials, such as clay, sand, gravel, and crushed stone, for local consumption. Quantities were not available, but were presumably very low because no significant construction projects have been noted in the press since the early 1980's. Geothermal energy was considered to be possibility for development. The outlook on minerals output, however, was for no significant change. The former French colony was dependent on imports to meet its energy and cement needs.

The economy of Comoros is based on the export of agricultural products, chiefly spices. Political instability in recent years has continued to have a negative affect on the economy.

Mauritius

The Republic of Mauritius has a total area of 1,860 km^2 and is located about 1,000 kilometers (km) east of Madagascar. In 1996, the population was 1.16 million, and the GDP per capita, based on purchasing power parity, was estimated to be a healthy $10,300. The mineral industry of Mauritius was a negligible factor in an economy that was based chiefly on tourism, financial services, and the export of sugar and textiles. It maintained a favorable foreign investment climate and a Free Port Authority.

Historically, mineral output consisted of the local production and use of basalt construction stone, coral sand, lime from coral, and solar-evaporated sea salt. Quantitative information was rarely available and then appeared to be inconsistent. Data on production of mineral commodities was not available, but on the basis of past activity, Mauritius produced about 7,000 metric tons per year (t/yr) of lime, 6,000 t/yr of salt, 300,000 t/yr of sand, and 1,000,000 t/yr of stone. Environmental concerns regarding the mining of coral sand and its impact on coastal lagoons were being raised.

Polymetallic nodules occurred on the ocean floor at a depth of about 4,000 meters, extending from 400 to 800 km north of Port Louis, northeast of Tromelin Island. The nodules averaged more than 15% each of iron and manganese and more than 0.3% of cobalt, with a concentration averaging from 2 to 6 kilograms per square meter. The abundance of land-based resources of these commodities made it unlikely that these resources would be developed in the foreseeable future.

Although the country was totally dependent on imports for its energy requirements, oil possibilities were of interest east of the polymetallic nodules area at shallower depth. In the 1970's, Texaco had explored the area using geophysics and drilling; the results were inconclusive. Energy consumption came from electricity (10.5%), coal (5.4%), and oil-derived products (84.1%). Mauritius consumed about 570,000 metric tons of oil products in 1993 and was growing at a rate of about 7% per year (Mbendi Information Services, August 17, 1997, Mauritius; Oil Industry Profile, accessed September 15, 1997, at URL http://mbendi.co.za/cymroi.htm).

Steel reinforcing bars were made from imported ingot at three rolling mills. The near-term outlook for the exploitation of minerals other than construction materials was negligible.

Reunion

Reunion, an overseas department of France, has a total area of 2,510 km^2 and is located about 650 km east of Madagascar. In 1996, the population was 705,000, and the GDP per capita, based on purchasing power parity, was estimated to be $4,300. It has an agricultural economy dominated by sugar cane exports. Mineral commodities production represented only a small part of the economy of Reunion, although little quantitative information was available. Output of hydraulic cement, made by grinding imported clinker, however, presumably remained substantial, well above 300,000 t/yr. The plant, owned by Ciments de Bourbon S.A. at Le Port, had a capacity of 350,000 t/yr. Additionally, production of basic volcanic rock and sea coast coral undoubtedly continued to meet local construction needs. Little change in future mineral activity was anticipated.

Seychelles

The Republic of Seychelles is a group of 40 granitic and 50 or more coralline islands with a total area of 455 km^2, located in the Indian Ocean, northeast of Madagascar. In 1997, the population was around 78,000, and the GDP per capita, based on purchasing power parity, was estimated to be $7,000. The economy was based on tuna fishing and tourism. Mineral production in Seychelles consisted mostly of unspecified quantities of construction materials—clay, coral, sand, and stone. Although output of guano, an organic phosphate fertilizer comprised of bird droppings, ceased in the mid-1980's, a 5,000-t/yr-capacity plant remained, and occasional small production was unofficially reported.

Granite in the bedrock of Mahe and nearby islands had some economic potential. It had been quarried for dimension stone on a trial basis by an Italian firm in the early 1980's. In 1992, Gondwana Granite, a South African company, was granted a license to extract and export up to 3,000 cubic meters of granite

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for use in tile and statuary products. Lime and cement production from the abundant coral also continued to be considered. Preservationists and other environmentally concerned groups, however, opposed both the granite and coral use projects. Polymetallic nodules were known to occur on the ocean bottom near the Admirante Islands. Limited sampling was done in the mid-1980's, but funds for further planned work were not available.

The oil potential of the entire Seychelles region continued to be promoted by the Government-owned Seychelles National Oil Company (SNOC) through the Petroleum Mining Act of 1976. Tar balls from subsurface seeps have long been known to wash up on the beaches of Coetivy Island, as well as on Mahe and some nearby islands. Exploration began in 1969, and by 1994, 23,150 km of seismic profiles and 27,911 km of aeromagnetic lines had been accumulated. Active exploration through 1995 had failed to discover any commercial petroleum sources. A comprehensive report on the Seychelles geology, hydrocarbon potential, historical exploration activity, geophysical data availability, and the terms of SNOC's Model Petroleum Agreement are available through this Mbendi Internet site (Mbendi Information Services, August 17, 1997, Seychelles, Oil Industry Upstream Profile, accessed September 15, 1997, at URL http://mbendi.co.za/indy/oilg/oilgseus.stm).

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THE MINERAL INDUSTRY OF

KENYA

By Philip M. Mobbs

Kenya, with its cement plants, petroleum refinery, and steel mills, was the most industrialized country in eastern Africa. Cement, petroleum products, semiprecious gemstones, and soda ash were the most economically significant mineral commodities produced. Other mineral and mineral-based commodities produced in Kenya included fluorspar, gold, gypsum, lime, salt, and steel products. Mining and quarrying accounted for less than 1% of the country's gross domestic product (GDP) which was $8.8 billion in 1997.

The country's economic performance was depressed in 1997. Real GDP growth was 2.3% compared with 4.6% in 1996 (Central Bank of Kenya, July 1, 1998, July 1998 economic review, accessed November 17, 1998, at URL http://www.centralbank.go.ke/cbk/19980701/2.html). Reasons cited by the Central Bank for the downturn included low domestic and foreign investor confidence, the poor condition of Kenya's infrastructure, and the negative effects of recent violence on the tourist industry (Central Bank of Kenya, July 1, 1998, Economic growth update, accessed November 17, 1998, at URL http://home.centralbank.go.ke/MonthlyReviews/ShowReview.asp?DocumentID=657).

The intrigue surrounding Goldenberg International again adversely affected Kenya's economy. For alleged exports made between 1991 and 1993, Goldenberg International, a former gold and precious stone exporter, received an estimated $100 million from a state agency through a Government export incentive program. The export scheme was blamed for severely straining Kenya's economic and political framework and for fueling inflation that reached 100% in 1993. During 1997, legal proceedings against Goldenberg and former Government officials were dismissed on technical grounds. Subsequently, because of the perception that the Government was not adequately confronting the alleged corruption issues, the International Monetary Fund suspended disbursement of $37 million to Kenya, part of a $216 million enhanced structural adjustment facility (loan program) initiated in 1996 (Financial Times, 1997a, b; Kelly, 1998; Daily Nation, October 23, 1998, Gem exports had shortcomings—Court, accessed on October 23, 1998, at URL http://www.nationaudio.com/News/DailyNation/Today/News/News15.html).

Kenya's major trading partners in Africa and the European Union received about 80% of the nation's exports. Agricultural products dominated the export market, but fluorspar, gemstones, petroleum products, soda ash, and steel products were notable sources of foreign exchange earnings. Petroleum products, refined primarily from crude oil imported from the United Arab Emirates, were re-exported to neighboring African countries, particularly Uganda. In 1997, Kenya joined a regional trade group, the Indian Ocean Rim Association for Regional Cooperation.

Mining was covered by the Mining Act, Chapter 306, of the Laws of Kenya. The Act will be replaced by the Mining and Minerals Bill that is under Parliamentary review. Additionally, the mineral industry was covered by the Customs and Excise Act, the Foreign Investment Protection Act, the Income Tax Act, and the Value Added Tax Act. The corporate income tax rate in Kenya was 35%. The Government encouraged the diversification of the mineral industry, indicating that known barite, chromite, copper, graphite, nickel, niobium, pyrite, rare-earth elements, silver, dimension stone, talc, wollastonite, and zinc deposits needed additional investigation (Ministry of Environment and Natural Resources, 1997).

The Mombasa-based Kaluworks and other aluminum rolling mills in Kenya processed about 6,000 metric tons per year (t/yr) of rolled aluminum. About 2,400 metric tons (t) were derived from locally sourced scrap; much of the remainder was imported as ingot primarily from South Africa.

Gold production was mainly artisanal. *(See table 1.)* Depressed gold prices dampened international gold exploration interest in Kenya. Anglo American Prospecting Services Ltd., a subsidiary of Anglo American Corp. of South Africa, continued exploration on the Lolgorien and the Akala concessions in a joint venture with International Gold Exploration AB of Sweden (IGE). IGE was treating tailings from a gold mine dump on the Lolgorien property and also held the Karasuk, the Sekerr, and the Wakorr gold concessions. Auvista Minerals NL, a subsidiary of Panorama Resources NL of Australia, explored the Migori gold prospect. Auvista was earning 100% interest in the prospect from Mio Migori Mining Co. Ltd. of Kenya; Panorama's fiscal problems, however, adversely affected Auvista's operations in Kenya. In December, Panorama announced a plan to merge with Tanganyika Gold NL of Australia. Pan African Resources Corp. of Canada (PARC), a subsidiary of Golden Star Resources Ltd., held a 75% interest in the Ndori gold prospect in southwestern Kenya in a joint venture with San Martin Mining Research and Investment Co. Ltd. of Switzerland. In 1997, PARC completed a reconnaissance exploration program on the property. San Martin continued to reprocess tailings from old gold mine dumps near Lake Victoria.

Clustered primarily near the port of Mombasa were a number of cold rolling steel mills, including the 120,000-t/yr Mabati Rolling Mills Ltd., the 36,000-t/yr Standard Rolling Mills, the 30,000-t/yr Steelmakers Ltd., and the 30,000-t/yr Kenya United Steel Co. Ltd. Premium Rolling Mills was located near Nairobi. Most of the mills rerolled imported steel. Steel also was produced at the 24,000-t/yr-capacity Kenya United Steel and the 600-t/yr Steelmakers plants. Electrical brownouts and power rationing adversely affected steel production and milling.

Tiomin Resources Inc. of Canada continued work on its special prospecting licenses covering, from north to south, the Sabaki, the Mambrui, the Sokoke, the Mombasa, and the Kwale titanium-bearing, heavy mineral sand concessions. Prefeasibility studies were done on the Kwale and the Mambrui permits, which were

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being used as farmland. Results of drilling during 1997 allowed Tiomin to increase the heavy mineral resources attributed to the properties. The resource of mineralized sands at Kwale was increased from 130 million metric tons (Mt) to 200 Mt, containing an estimated 4.2 Mt of ilmenite, 1.1 Mt of rutile, and 600,000 t of zircon at a 1% heavy-mineral cut-off grade (Canada NewsWire, November 12, 1997, Significant ore reserves increase at Tiomin's Kwale titanium sands deposit in Kenya, accessed November 21, 1997, at URL http://www.newswire.ca/releases/November1997/12/c2489.html). Resources at Mambrui were increased from 650 to 700 Mt of sand, grading 3% heavy minerals, and those at Sokoke from 1,200 to 1,700 Mt of sand, grading about 3% heavy minerals. Tiomin proceeded to secure Government permits and to lease property for the proposed $96 million Kwale project (Industrial Minerals, 1997; Mining Journal, 1997). Pangea Goldfields Inc. of Canada held a 20% interest in the venture.

Athi River Mining Ltd., the nation's smallest cement producer, became a publicly owned company in 1997. Athi River began construction of a 35,000-t/yr-capacity cement kiln and a 75-metric-ton-per-day lime plant to supplement output from the current 75,000-t/yr-capacity Mombasa cement plant. El Niño rains reduced production in 1997; the limestone quarries were flooded for most of October and November, and local access roads and electric power lines were washed away. Bamburi Cement Ltd. of Mombasa initiated construction of a $40 million cement-clinker-grinding plant near Nairobi in May.

Magadi Soda Co. Ltd., a subsidiary of Brunner Mond plc of the United Kingdom, was forced to find new markets for soda ash exports as the economic crisis in Asia deepened. At the beginning of the year, nearly 75% of Kenyan soda ash was exported to Southeast Asia compared with about 60% at yearend. Exports were shifted to the Indian and the South African markets. Magadi Soda commissioned a new grinding and screening plant during the year. The company's shipping bottleneck was being addressed. An $8.9 million rehabilitation of the rail line from Magadi to Konza was completed; the company had assumed maintenance responsibility of the line as part of the privatization of Kenya Railways Corp. General Electric Co. (GE) of the United States was overhauling five locomotives leased from Kenya Railway for use by the newly formed Magadi Railway Co. on the rail line from Magadi to Mombasa via Konza. GE also secured the contract for continued maintenance of the locomotives. Magadi Soda anticipated that its operation of the railways would increase utilization of railcars (Brunner Mond plc, March 12, 1998, Magadi company inaugurates locomotive engines, accessed November 20, 1998, at URL http://www.brunnermond/com.pr-msrail.htm). A quicker railcar return from the docks would allow up to a 50% increase in soda ash shipments.

Petroleum exploration resumed in July when Tornado Resources Ltd. of Canada acquired Block L-1 in the Mandera Basin and Block L-10 in the offshore Lamu Basin under production-sharing agreements. Transportation of petroleum products from the Mombasa refinery to the interior was primarily via the pipeline of the Government-owned Kenya Pipelines Co. Ltd. The extension of the pipeline into Uganda was being studied.

The Kenya Railways Corp. single-track line runs from the west near Tororo, Uganda, passes through Nairobi, and terminates at the port of Mombasa, connecting key mining districts along the route. CPCS Transcom Ltd. of Canada began a study of Kenya Railways privatization options at yearend. Kenya's 68,000-kilometer road system was in poor condition; maintenance problems were exacerbated by the heavy rains in October and November that washed away bridges and roadbeds. Electricity demand continued to outpace supply (Indian Ocean Newsletter, 1997). Primarily derived from hydroelectric sources, Kenya had an electric generating capacity of about 872 megawatts (MW) after a 45-MW diesel-fueled plant in Nairobi and a 43-MW barge-mounted plant in Mombasa came online in 1997. About 30 MW was imported from Uganda. Construction of a 75-MW powerplant at Kipevu in Mombasa was begun in December; the plant is expected to be online in late 1999. Two 64-MW geothermal plants were under study for Olkaria. Also during 1997, the Electric Power Bill ended the monopoly on power generation held by Kenya Power and Light Co.

The outlook for the mineral industry of Kenya is good, with the Government continuing policies directed toward increasing domestic employment and foreign earnings through mineral production projects. Political instability should be reduced in the wake of the general elections held in December 1997. Heavy El Niño rains forecast to continue into 1998 would persist in degrading Kenya's rail and road infrastructure.

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TABLE I
KENYA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Aluminum, secondary e/		2,400	2,400	2,400	2,400	2,400
Barite		14	20	20 e/	20 e/	20
Carbon dioxide gas, natural		5,910	5,605	7,982	9,119	9,100
Cement, hydraulic	thousand tons	1,417	1,182	1,122	1,102	1,000
Clays, kaolin		7	69	300	595	500
Diatomite		829	592	457	415 r/	400
Feldspar e/		1,200	1,200	500	100	100
Fluorspar (acid grade)		78,725	53,400	80,230	83,000	69,000
Gemstones, precious and semiprecious:						
Amethyst e/	kilograms	303 3/	303	310	300	300
Aquamarine	do.	43	14	50 e/	50 e/	50
Cordierite (Iolite) e/	do.	14 3/	15	15	15	15
Garnet	do.	31	42	119	120 e/	120
Ruby	do.	120 e/	200	1,200	1,200 e/	1,200
Sapphire e/	do.	2,314 3/	2,310	2,300	2,300	2,300
Tourmaline	do.	229	43	224	250 e/	250
Gold, mine output, Au content e/	do.	154 3/	155	170	300	300
Gypsum and anhydrite e/		36,000	30,000	28,000	28,000	25,000
Lead, mine output, Pb content		396 e/	350	4	5 e/	5
Lime e/		12,000	12,000	12,000	15,000	15,000
Petroleum refinery products e/	thousand 42-gallon barrels	17,000	16,200	16,000	16,000	16,000
Salt, crude		74,669	70,500	71,400	41,000	50,000
Soda ash		144,850	226,150	218,450	223,000	230,000
Steel, crude e/	thousand tons	20	20	20	20	20
Stone, sand and gravel:						
Coral e/	thousand tons	1,600	1,600	1,600	1,000	1,000
Limestone for cement	do.	400	300	300	600	700
Limestone for dimension stone	do.	25	30	31	32	32
Sand, industrial (glass) e/		12,300	12,300	12,300	13,000	13,000
Shale e/		200,000 r/	150,000 r/	120,000 r/	120,000 r/	200,000
Vermiculite		1,961	1,113 e/	457	734	800
Wollastonite		100 e/	--	--	--	--

e/ Estimated. r/ Revised.

1/ Includes data available through November 23, 1998.

2/ In addition to the commodities listed, a variety of industrial minerals and construction materials (brick clays, gravel, iron ore, kyanite, marble, crushed rock, and construction sand) are produced, but quantities are not reported, and information is inadequate to make reliable estimates of output.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

LESOTHO

By George J. Coakley

The landlocked, 30,350-square-kilometer nation of Lesotho is an independent enclave within the Republic of South Africa. In 1997, the population was 2 million, and the gross domestic product (GDP) per capita, based on purchasing power parity, was estimated to be $2,500. The minerals industry was not a significant part of the economy; repatriated wages from Basotho miners working in the South African gold mines, however, added one-third to the GDP. Additional revenue was generated from the sale of water to South Africa through the Lesotho Highlands Water Project (HWP) in the Maluti Mountains. The first dam of this project was completed in 1996. Total cost of the HWP, which was being funded by the World Bank, was estimated to be $4 billion dollars.

Commercial interest in the mineral resources of Lesotho was limited to diamonds. Lesotho has long been known as a source of diamonds, mostly from alluvial deposits. In recent years, 33 kimberlite and 140 dykes, of which 24 are diamondiferous, have been identified by the Lesotho Geological Survey. Artisanal miners produced a small amount of clay, crushed stone, and sand and gravel for domestic consumption. Artisanal diamond production was around 1,500 carats per year (kt/yr), and Messina Diamond Corp. of Canada reported 1997 exports of 8,160 carats of diamonds, valued at $366,533, derived from sampling of the Liqhobong kimberlite pipes (Whitelock, 1998). The exploration and drilling program completed at Liqhobong in December 1996 identified two mineralized kimberlite pipes—the Main and the Satellite. Resource estimates at the Main Pipe were 99 million metric tons (Mt) to a depth of 650 meters (m), with a +1-millimeter (mm) microdiamond grade of 49 carats per hundred tons. Tonnage estimates were 50 Mt to a depth of 250 m and 26 Mt to 125 m. Resource estimates at the Satellite Pipe were 4 Mt to a depth of 125 m, with a +1-mm microdiamond grade of 139 carats per hundred tons. The prefeasibility study for the project, completed in 1997, indicated that a 2.6 million-metric-ton-per-year open-pit mine could produce 700,000 kt/yr. A full scale bulk sampling of the two pipes will begin in July 1998, with a bankable feasibility study expected to be completed in early 1999 (Messina Diamond Corporation, 1998, Development and exploration, accessed January 12, 1999, at URL http://www.messinadiamond.com/frames-dev-exp.html).

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Energy and Mining
Maseru, Lesotho

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THE MINERAL INDUSTRY OF

LIBERIA

By Philip M. Mobbs

The mineral economy of Liberia was attempting to recover from the civil war that started in 1989. Liberian Resources Co., a joint venture between the Government and subsidiaries of Amalia Gold Mining & Exploration Co. of South Africa, was formed in 1997 to manage the rehabilitation of the mineral industry.

Mineral production consisted mainly of artisanally mined diamond and gold. *(See table 1.)* For more extensive coverage of the mineral industry of Liberia, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
LIBERIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Cement, hydraulic		8,300	--	--	--	--
Diamond	carats	150,000	100,000	150,000	150,000	150,000
Gold	kilograms	700	700	800	700	500

1/ Includes data available through August 13, 1998.
2/ In addition to the commodities listed, a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone) are produced; but information is inadequate to make reliable estimates of output.

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THE MINERAL INDUSTRY OF

LIBYA

By Bernadette Michalski

The hydrocarbon sector accounted for nearly 95% of Libya's revenues. Petroleum reserves (29.5 billion barrels) were the largest on the African Continent but remained under exploited. Libya was, however, the second largest crude oil producer in Africa, following Nigeria, and exported an average of 1.2 million barrels per day in 1997; Italy was the leading market, followed by Germany, Spain, and Greece. Petroleum product exports averaged 100,000 barrels per day in 1997. Proven natural gas reserves were 1.3 trillion cubic meters. Annual natural gas production averaged more than 6 billion cubic meters in recent years (Arab Petroleum Research Center, 1998, p. 261). Nonfuel mineral output was confined to the production of steel from the heavily subsidized Misurata Complex, now operating at about three-fourths of its design capacity of 1.2 million metric tons per year; the extraction of salt from the coastal plains near Benghazi and Tripoli; and the quarrying of gypsum, and limestone, near Al Khums. For more extensive coverage of the mineral industry of Libya, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

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TABLE 1
LIBYA: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Cement, hydraulic		2,300	2,700	3,210	3,550 r/	3,500
Gas, natural: e/						
Gross	million cubic meters	12,410	12,510	12,460	12,640 r/	12,500
Dry	do.	6,360	6,390	6,345	6,420 r/	6,300
Gypsum e/		160	180	180	180	180
Iron and steel:						
Metal:						
Direct-reduced iron		944	852	963	862	990 3/
Crude steel		920	874	909	863 r/	897 3/
Lime e/		260	260	260	260	275
Nitrogen:						
N content of ammonia		350	350	534 r/	545 r/	536 3/
N content of urea		269	347	409	399	383 3/
Petroleum:						
Crude	thousand 42-gallon barrels	496,765	507,313	509,175 r/	511,000	516,475 3/
Refinery products:						
Gasoline	do.	15,480	16,000	15,500	16,000 r/	16,200
Kerosene and jet fuel	do.	13,578	13,800	13,700	14,200 r/	14,300
Distillate fuel oil	do.	28,908	29,600	29,000	31,400 r/	31,500
Residual fuel oil	do.	32,448	32,500	32,000	35,400 r/	35,500
Other	do.	9,272	10,200	10,500	18,000 r/	18,000
Total	do.	99,686	102,100	100,700	115,000 r/	115,500
Salt		15	30 r/	30 r/	30 r/	30
Sulfur, byproduct of petroleum and natural gas e/		13 r/	13 r/	13 r/	13 r/	13

e/ Estimated. r/ Revised.

1/ Table includes data available through August 15, 1998.

2/ In addition to the commodities listed, a variety of construction stone, brick, and tile was produced, but available information was inadequate to make reliable estimates of output levels. Natural gas liquids were also produced but were blended with crude petroleum and were reported as part of that total.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

MADAGASCAR

By George J. Coakley

The Republic of Madagascar, the world's fourth largest island, is located about 420 kilometers (km) east of Mozambique in the Indian Ocean and has an area of 581,540 square kilometers (km²). The area supported a population of 14.1 million in 1997 with a gross domestic product (GDP) per capita of $880, based on 1996 purchasing power parity data. Mineral production plays a secondary role to agriculture and fishing in the economy of Madagascar. Mining accounts for 3% of GDP and based on the latest available United Nations data for 1995 accounted for $27.9 million, or about 8% of total exports. The Malagasy mining industry was chiefly noted for its production and export of chemical- and metallurgical-grade chromite ore, high-quality crystalline flake graphite, and mica. In addition to these minerals, small quantities of gold and rare earths were produced, along with some industrial mineral commodities, including cement, feldspar, a variety of semiprecious gemstones, quartz, and salt. In recent years, active exploration on the island has targeted semiprecious gemstones, gold, nickel, and titanium. Production of refined petroleum from imported crude remained modest, and exploration for hydrocarbon resources continued. The Government had nationalized all mineral resources, with the exception of graphite and mica, in 1975.

As part of the World Bank and International Monetary Fund Structural Adjustment Program, the Ministry of Energy and Mines reaffirmed its commitment to privatize parastatal companies in the mining and petroleum sectors in 1997. Legislation controlling investment and mining in Madagascar included the Investment Code, law No. 85-001 and the Mining Code, law No. 90-017 of 1990, which revised and augmented law No. 89/007 of December 12, 1989. A scheduled revision of the 1990 mining permits code had yet to take place despite the rejection of the current mining code by operators in 1994. The 1990 Mining Code made provisions for three types of mining permits, which were further subdivided into exploration and exploitation permits. Exploration and exploitation type 1 permits were granted only to individuals or groups of Malagasy nationality and were valid for 2 years. Types 2 and 3 permits, valid for 3 and 5 years, respectively, were designed for small to large mining companies incorporated under Malagasy law. Under the mining code, the maximum size areas of types 2 and 3 exploration permits were 400 and 1,000 km², respectively. Following a 75 % reduction in land holdings during the exploration phase, the next types 2 and 3 exploitation permits allowed for maximum holdings of 100 and 200 km², respectively. The Malagasy Parliament passed a new petroleum law in 1995, an English summary of which is available in the 1996 International Petroleum Encyclopedia (PennWell Publishing Co., 1997).

The restructuring and privatization of Solitany Malagasy (SOLIMA), which operated the petroleum refinery at Tamatave, remained a Government priority with international bids solicited at yearend for the sale of SOLIMA's distribution system. In 1997, the Tamatave refinery, severely damaged by a typhoon in April 1994, continued to operate at a reduced capacity of only 450,000 metric tons per year (t/yr) and was considered to be a less attractive privatization opportunity by foreign investors (Indian Ocean Newsletter, 1997).

QIT-Fer et Titane Inc. (QIT), a Canadian subsidiary of Rio Tinto plc of the United Kingdom, has conducted extensive field studies on the social and environmental aspects of a proposed mining project for titanium minerals in the Fort Dauphin region of southern Madagascar since 1987. The environmental organization, Friends of the Earth, have opposed the project based upon its potential to destroy significant forest habitats supporting a unique species biodiversity, although others have argued that mining might be less disruptive to the forests than the damage being caused by native slash-and-burn agriculture (Colin Barraclough, October 2, 1997, Madagascar mining—A silver lining, accessed May 22, 1998, at URL http://www.csmonitor.com/durable/1997/10/02/intl/intl.3.html).

QIT planned to complete a comprehensive Environmental Review Process prior to any commencement of mining operations. In parallel over the past years, QIT and the Government of Madagascar have been conducting negotiations to conclude a Framework Agreement to support the development of the proposed mining project in the event of a favorable outcome from the environmental review process. This agreement will incorporate the salient features of existing Madagascar laws and investment codes, as well as features that would provide the legal, fiscal, and other assurances that will be needed to secure financing for the project. Against a backdrop of political change and policy evaluation that has been ongoing since 1991, it has been difficult for QIT and the Government negotiators to finalize the Framework Agreement for the proposed project. Additional required social, environmental, and technical studies are being held up pending signature of the Framework Agreement. As a result, it has been difficult to predict a schedule for development (Rio Tinto plc, 1997, QIT and Madagascar, accessed November 6, 1997, at URL http://www.riotinto.com/br02.htm).

The Government continued to seek multilateral and bilateral cooperation to aid in controlling the degradation of the environment incurred during the past few years. Uncontrolled slash-and-burn cultivation, deforestation, livestock overgrazing, and massive erosion threatened Madagascar's agricultural and hydroelectric potential and the country's unique wildlife.

Estimates of 1997 production levels of all mineral commodities are shown in table 1. Mineral exports, with the exception of mineral samples associated with exploration, must be authorized

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by the Ministry of Energy and Mines (MEM). Smuggling of undocumented gold and semiprecious stones out of the country remained a problem. MEM formed a new gold trading agency in 1995 in an attempt to increase the Government's share of revenue from gold production and trade. The Government's official gold export statistics have ranged from 37 kilograms (kg) in 1992 to less than 1 kg in 1993; actual production and illegal export of gold in recent years may range from 500 kilograms per year (kg/yr) to as much as 3,000 kg/yr. This illegal trade is of concern to the Government, which has sought cooperation from neighboring nations, such as Mauritius, to help interdict gold smuggling.

Madagascar imported essentially all its crude petroleum and some petroleum products, which was a significant burden to the economy. In any given year, the value of petroleum imports was equivalent to 15% to 30% of the total foreign exchange earned from all export revenues.

The chromite industry, located in Andriamena, is controlled by the parastatal Société Kraomita Malagasy (KRAOMA). Graphite and mica production are owned and operated by foreign entities, but the Government had significant influence on these operations through taxes, royalties, and official approval of all foreign exchange transactions.

Office des Mines Nationales et des Industries Stratégiques (OMNIS), created in 1976, was involved primarily in research, joint ventures, and promotion of Madagascar's mineral resources, including hydrocarbons, and acted as the repository of the acquired exploration data. MEM, through the Directorate of Energy, had primary responsibility for the energy sector. MEM also directed SOLIMA and the Electricity and Water Co. The distribution, importation, and refining of petroleum products were managed by SOLIMA.

Chromite production from the Andriamena district, which began in 1967, has remained relatively stable in recent years. By 1997, a minimum of 25 chromite lenses had been identified within the dunite host rocks of the Andriamena complex, and more lenses may yet be identified. Ore beneficiation enabled KRAOMA to produce a chromite concentrate grading from 48% to 50% chromium oxide (Cr_2O_3) with 0.002% to 0.003% phosphorus and lumpy chrome ore grading from 42% to 44% Cr_2O_3. Typically, crude Malagasy chromite contained 0.007% phosphorus. With the startup of its new mine at Bemanevika in 1996, KRAOMA has expanded chromite production to the 135,000- to 140,000 t/yr. The Bemanevika Mine was reported to have reserves of 3 million metric tons (Mt) of chromite.

Madagascar had some scattered placer and lode gold deposits, and a large black market reportedly existed for the mining and sale of gold. Gold mining was primarily artisanal and employed approximately 5,000 to 10,000 people. In 1997, Riosun Resources Corp. of Canada acquired the gold mining interests in northern Madagascar of Glamorgan Group Ltd.

Phelps Dodge Mining Co. of the United States announced the discovery of a potentially significant nickel laterite deposit in Ambatovy, central Madagascar, 80 km east of Antananarivo. As a result of exploration during 1996 and 1997, Phelps Dodge identified an area of laterite mineralization that is more than 45 meters thick and contains an estimated 52 Mt of ferralite and saprolite ore with a grade of 1.24% nickel and 0.09% cobalt and 0.80% magnesium at a cutoff grade of 0.80% nickel. An overall resource for the area was estimated to be 168 Mt at a grade of 1.11% nickel and 0.10% cobalt. Initial tests by Hazen Research, Inc. showed that favorable metal recoveries are obtainable by using proven hydrometallurgical technology. A detailed feasibility study and an environmental assessment will be completed in early 1998 (Phelps Dodge Mining Co., 1998).

The artisanal gemstone mining sector was active but largely uncontrolled and had known but unreported production of emeralds, sapphires, and other semiprecious stones. As with gold, proposed Government efforts to organize and regulate these small-scale mining activities will have the potential to increase formal export earnings and the Government tax base significantly. In late 1996, the discovery of a prolific, low-quality sapphire deposit in the Ankarana Special Reserve, an internationally recognized park, triggered a major influx of 12,000 to 15,000 artisanal miners to the area. With local resources insufficient to enforce legal conventions concerning sapphire mining, more than 30% of the Reserve had been exploited by the artisanal miners by yearend. An emergency committee comprised of national and local government officials was formed to curtail the illegal mining, to assess the long-term environmental impacts of mining on the Ankarana Special Reserve, and to explore alternative income-generation options for the miners (U.S. Embassy, Antananarivo, Madagascar, 1997).

During 1997, Riosun acquired an 80% interest in Export-Import Madagascar (Eximad) S.A.R.L. which operates the Toby Steven emerald mine in the southern part of the country. A description of the geologic setting of the emerald and sapphire deposits of southern Madagascar was reported recently by the Bureau de Recherches Géologiques et Minières of France (Bureau de Recherches Géologiques et Minières, 1996). Both gemstones are found in structurally controlled deposits in crystalline schists. The emerald deposits at Andonabe, Anapera, and Beandry are associated with amphibolite facies biotite gneisses and amphibolites of the early Proterozoic Vohibory System, and the sapphire deposits at Analalava, Andranondambo, Ankazoabo, and Anterimena in the south are associated with granulite facies cordierite and biotite gneisses, marbles, and pyroxenites of the Archean Androyen System.

Madagascar continued to be a producer and exporter of high-quality crystalline flake graphite, with an estimated 16,000 metric tons being produced in 1997. Graphite was produced in Madagascar by five main companies, all headquartered in Antananarivo. Société Minière de la Grande Ile's (SMGI) Ambatomitamba graphite mine was the largest single producer, processing around 4,000 t/yr of 92% flake graphite. The other four operators were Etablissements Gallois, Société Louys, Etablissements Izouard, and Etablissements Rostaing. Three mines, with production of about 6,000 t/yr of graphite with a carbon content of 90% to 95% were operated by SMGI. SMGI was 100% owned by the French company, Societe Participation Industrielle et Minières, which also owned Societe des Mines d'Ampandrandava's two phlogopite mica mines at Ampandrandava and Sakamasy.

Madagascar was essentially entirely dependent on imports of crude petroleum to meet its energy needs. Total petroleum

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consumption averaged about 26 million barrels per year. During the past several years, the amount of oil exploration by foreign companies in Madagascar has been modest. No significant commercial hydrocarbon finds have, however, been reported. According to Mbendi Information Services, OMNIS opened the country's entire onshore and offshore areas for petroleum exploration in the country's first formal licensing round in March 1995. It also revised its petroleum fiscal terms to bring them in line with the favorable conditions available in other frontier exploration areas in Africa. Triton Energy Ltd. of the United States and Gulfstream Resources Canada Ltd. held active offshore petroleum exploration agreements with OMNIS (Mbendi Information Services, August 13, 1997, Madagascar oil industry profile, accessed March 29, 1998, at URL http://mbendi.co.za.cymdoi.htm). In 1997, Gulfstream Resources acquired an 82% interest in the 26,700-km^2 Tsiribihina Block in the Morondava onshore basin and an 80% interest in the 5,200-km^2 Antonibe Block in the Majunga offshore basin. A 300-km seismic program in late 1997 will be followed by a multiwell drilling program in 1998. Several wells were drilled in the target area, one of which had an estimated 56.6 billion cubic meters of natural gas in place (Gulfstream Resources Canada Ltd, June 30, 1997, Gulfstream accelerates activity in Madagascar, accessed May 15, 1998, at URL http://www.gur.com/pressrel.html#30/06/97). In July 1997, Triton acquired the 28,170-km^2 offshore Ambilobe Block in the north and a 27,520-km^2 onshore property at the southern tip of the island.

Madagascar had producing resources of chromite, graphite, and mica and known deposits of bastnaesite, a rare-earth mineral, bauxite, ilmenite, iron ore, and nickel. Resources of gold and semiprecious gemstones were exploited at the artisanal level, but the economics of exploiting them as medium- to large-scale mining operations were undetermined. Deposits of coal, lignite, and uranium minerals also were known.

Infrastructure development in Madagascar was inadequate for most mining development. Additional investment was needed to improve the road system and the telecommunications network. The hydroelectric potential of Madagascar was estimated to be 14,000 megawatts (MW) but remained underexploited. Current installed hydropower capacity is 106 MW. Petroleum loading and unloading facilities were at Toamasina/Tamatave but were limited to oceangoing vessels of 50,000 deadweight tons. World Bank and International Monetary Fund economic stimulus programs were implemented to accelerate the Government's liberalization and privatization efforts and to create the economic and legal environment needed to attract foreign investment in the mining, energy, and other sectors. Increasingly strict environmental protection concerns, such as those that resulted from titanium sands mining proposals and recent illegal artisanal sapphire mining, may serve to inhibit new capital investment in the mining sector, at least in the short term.

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TABLE 1
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES 1/

(Kilograms unless otherwise specified)

Commodity 2/		1993	1994	1995	1996 e/	1997 e/
METALS						
Beryllium, beryl in quartz concentrates, industrial and ornamental e/		3,000	3,000	31,666 3/	32,000	32,000
Chromium:						
Chromite concentrate, gross weight	metric tons	60,900	42,700	49,702	54,900	55,900
Chromite ore, lumpy	do.	83,300	47,500	56,405	82,300	83,800
Total	do.	144,200	90,200	106,107	137,200 3/	139,700 3/
Gold, mine output, Au content e/ 4/		500	500	38 3/	50	50
Rare-earth minerals: e/						
Bastnasite (60% REO)	metric tons	5	5	5	5	5
Monazite (55% REO)		100	100	100	100	100
INDUSTRIAL MINERALS						
Abrasives, natural (industrial only) e/		10,000	10,000	10,000	10,000	10,000
Cement, hydraulic e/	metric tons	60,000	60,000	60,000	60,000	60,000
Clay, kaolin e/	do.	700	700	1,545 3/	1,500	1,500
Feldspar e/		4,000	4,000	2,120 3/	2,000	2,000
Gemstones: e/ 5/						
Amazonite		2,000	2,000	2,000	2,000	2,000
Amethyst:						
Gem		1,700	1,700	1,700	1,700	1,700
Geodes		80	80	80	80	80
Graphite, all grades, shipments	metric tons	13,118 r/	14,593 r/	16,119	16,000	16,000
Mica, phlogopite: e/						
Block	do.	4	4	1	1	1
Scrap	do.	800 r/	300 r/	389	400 r/	400
Splittings and sheet	do.	76 r/	52 r/	42	49 r/	49
Total	do.	880 r/	356 r/	432	450 r/	450
Ornamental stones: e/ 6/						
Jasper		68,000	68,000	68,000	68,000	68,000
Labradorite		61,000	61,000	61,000	61,000	61,000
Quartz: e/ 7/						
Crystal		32,000	32,000	32,000	32,000	32,000
Piezoelectric		66,000	66,000	66,000	66,000	66,000
Rose quartz		27,000	27,000	27,000	27,000	27,000
Smelting		180,000	180,000	180,000	180,000	180,000
Salt, marine e/	metric tons	63,899 r/	75,783 r/	51,307 r/	50,000 e/	50,000
Stone: e/						
Calcite, industrial	do.	2,000	2,000	2,000	2,000	2,000
Dimension stone	do.	3,000	3,000	3,000	3,000	3,000
Marble, cipoline		1	1	1	1	1
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products: e/						
Gasoline	thousand 42-gallon barrels	900	225 3/	200 r/	200 r/	200
Kerosene and jet fuel	do.	400	100 3/	85 r/	85 r/	85
Distillate fuel oil	do.	290	70 3/	60 r/	60 r/	60
Residual fuel oil	do.	500	125 3/	100 r/	100 r/	100
Other	do.	20	5 3/	5 r/	5 r/	5
Total	do.	2,110	525 3/	450 r/	450 r/	450

e/ Estimated. r/ Revised.

1/ Includes data available through April 1998.

2/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Does not include an estimate of smuggled artisanal production.

5/ Reported output of other gemstones for 1996, in kilograms: cordierite, 3,942; garnet, 31,607; and tourmaline, 176,256. Most emerald and sapphire production is unreported.

6/ Other ornamental stones produced in 1996 for which data were reported, in kilograms: agate, 9,335; apatite, 16,982; aragonite, 569; calcite, 43,419; ruby, 48,194; and sapphire, 94.

7/ Other forms of quartz mined historically and estimated production, in kilograms: geodes, 2,500; hematoid, 300; and other ornamental quartz, 3,000.

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THE MINERAL INDUSTRY OF

MALAWI

By George J. Coakley

The Republic of Malawi is a landlocked country surrounded by Mozambique, Tanzania, and Zambia. It has an area of 119,140 square kilometers, of which 20% is Lake Malawi. In 1997, Malawi had a population of about 9.8 million and a gross domestic product (GDP) per capita, based on purchasing power parity, of $900. The economy of Malawi is based mostly on agriculture, which contributes to 35% of the GDP and for more than 90% of total export earnings (U.S. Embassy, Lilongwe, August 1996, FY 1997 country commercial guide, accessed August 12, 1997 on the World Wide Web at URL http://www.state.gov/www/about_state/business/com_guides/africa/malawi97.html.

The mineral sector contributed modestly to the economy and accounted for an estimated 3% of the GDP in 1996. Cement, coal, crushed stone for aggregates, dolomite, limestone, and some artisanal salt production were produced and consumed locally. *(See table 1.)* Malawi also produced small amounts of lime. Production of various gemstones, such as, in order of volume, rubies, sapphires, aquamarine, amethyst, garnet, and agate on a small scale and at organized levels, are also known. Coal from the Mchenga mine and limestone produced in Malawi were essential components of the country's cement and lime industries. The production of stone for aggregate and cement was the largest component, by value, of Malawi's mineral production.

The country has known mineral deposits of apatite, aquamarine, bauxite, corundum, glass sand, granite, graphite, kaolin, kyanite, monzanite, phosphate, pyrite, salt, tourmaline, uranium, and vermiculite. Resources of oil or natural gas are not known, and Malawi was planning to import 50 megawatts of electricity from the Cabora Bassa hydroelectric dam in Mozambique. Ashok Coal Mining Co. of Malawi was actively seeking investment partners to open a coal mine at Ngana, where proved and estimated coal reserves of 60 million metric tons have been identified. During 1997, investment interest was also being shown in the closed Katengeza graphite mine, the Kaycrekera uranium deposit, and the Bwanje valley limestone deposits (Malunga, 1998).

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TABLE 1
MALAWI: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1993	1994	1995	1996	1997
Cement, hydraulic		127,000	121,954	138,675	140,000 e/	175,800
Coal		52,800	34,630	14,635	69,930	63,210
Dolomite		2,000 e/	1,321	876	700 e/	700 e/
Gemstones, ruby and sapphire	kilograms	20,000 e/	21,454	75,588	100,000 e/	351
Lime		2,560 e/	3,544	1,119	3,150 r/	1,940
Stone:						
Crushed for aggregate	cubic meters	70,000 r/	65,039	65,601	58,700 r/	162,538
Limestone, for cement		126,000	173,758	175,578	133,648	258,000

e/ Estimated. r/ Revised.
1/ Estimated data are rounded to three significant digits.
2/ Table includes data available through May 21, 1999.
3/ In addition to commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and other stone) may also be produced, but information is inadequate to make reliable estimates of output levels.

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THE MINERAL INDUSTRY OF

MALI

By Philip M. Mobbs

Gold was the most economically significant mineral commodity produced in Mali during 1997. Production from the newly opened Sadiola Hill Mine propelled Mali to fourth on the list of African gold producers, after South Africa, Ghana, and Zimbabwe. Extensive gold exploration continued during the year in the Birimian Series greenstone belts in the southwestern and southern parts of the country near Bougouni, Kéniéba, and Sikasso. The country had a wide variety of other mineral deposits, but few have been developed because of the condition of the nation's transportation network and lack of local demand (United Nations, 1987, p. 39, p. 47, and p. 58; Abdrahamane Dicko, March 27, 1998, Société Express Bamako-Kayes—L'enfer roulant, Les Echos, accessed July 1, 1998, at URL http://malinet.ml/palabre/presse/les_echos/pages/ecmars98/ec940soc1a.html). Gold accounted for more than 95% of the estimated total value of mineral commodities produced in Mali. Gold exports increased to 18.5 metric tons (t) in 1997 compared with 6.6 t in 1996 (Mining Journal, 1998).

Mining was overseen by the Direction Nationale de Géologie et des Mines, which is part of the Ministère des Mines, de l'Energie et de l'Hydraulique. The mining code included Decree No. 96-214/PM-RM of August 16, 1996, Ordonnance No. 91-065/P-CTSP of September 19, 1991, Decree No. 91-277/PM-RM of September 1991, and Decree No. 91-278/PM-RM of September 1991. The Government had the right to 20% equity in all new mining ventures, of which 10% was a free share and the remainder, a buy-in option. Net profits were taxed at the rate of 35% after a 5-year exemption period. The ad valorem tax was 3%, and the depletion allowance was as high as 27.5%. Petroleum exploration and exploitation were regulated by Decree No. 30 of May 23, 1969, and by Decree No. 21, April 20, 1970. Produced petroleum was subject to a 6% royalty. Natural gas was subject to a 5% royalty if exported or a 3% royalty if the gas was for the domestic market.

The Malian gold rush continued during 1997. La Société d'Exploitation des Mines d'Or de Sadiola, S.A. (Semos), operated the open-pit Sadiola Hill Mine, about 80 kilometers (km) southwest of Kayes in western Mali. Semos is a consortium of Anmercosa Mining (West Africa) Ltd. (38%), a subsidiary of Anglo American Corp. of South Africa; AGEM Ltd. of Barbados (38%), a subsidiary of International African Mining Gold Corp. of Canada; the Government of Mali (18%); and the International Finance Corp. (IFC) (6%), a member of the World Bank Group. Ore was run through a semiautogenous grinding mill and leached with cyanide. Gold was recovered by two carbon-in-pulp processing lines. The $303 million mine began commercial operations on March 1, 1997, and produced 11.3 t of gold during the year (IAMGOLD, January 12, 1998, Sadiola gold mine to produce 500,000 ounces in 1998 at a direct cash cost of US$112 per ounce, email from portfolio@newswire.ca). Mine and plant operations reportedly exceeded the ore-handling design capacity of 4 million metric tons per year of ore during the last half of the year (IAMGOLD, November 12, 1997, IAMGOLD issues 1997 third quarter results, email from portfolio@newswire.ca). *(See table 1.)*

The Société des Mines d'Or de Syama, S.A. (Somisy), operated the open-pit gold mine at Syama, 75 km southwest of Sikasso. During 1997, Randgold Minerals Mali Inc. acquired an additional 10% equity interest in Somisy from the IFC. Somisy's ownership structure at yearend was Randgold (75%), the Government of Mali (20%), and the IFC (5%). Randgold reported that proven open-pit reserves at Syama were 15.71 million metric tons (Mt) at a grade of 4.4 grams per ton (g/t) of gold, measured/indicated gold resources from the open pit and potential underground operations were 12.7 Mt at a grade of 4.2 g/t, and measured gold resources of 3.76 Mt at a grade of 1.75 g/t in the medium-grade stockpiles (Randgold Resources Ltd., 1997, p. 26- 32). Randgold proposed a two-phase upgrade for the plant, including a new crusher, a new mill, and process-engineering changes.

JCI Ltd. of South Africa divested itself of its joint venture interest in the former Kalana underground gold mine. Nelson Gold Ltd. of Canada subsequently acquired 70% interest in the property from Ashanti Goldfields Co. Ltd. of Ghana, which retained 10% interest. A midyear feasibility study by Nelson proposed to deepen existing shafts and upgrade the plant's treatment capacity. Action on the proposal, however, was postponed because of declining gold prices. North of Kalana, Société pour le Developpment des Investissements en Afrique S.A. (Sodinaf) of Mali was engaged in predevelopment activities on the Kodieran permit. The proposed Kodieran open pit was projected to be Mali's third largest gold mine by 1999 (Geert De Clereq, September 2, 1997, Mali gold rush pits diggers against mining groups, accessed September 10, 1997, at URL http://eleet.org/Content?arn=a0401LBY322r...mining&lk=noframes&col=NX&kt=A&ak=allnews).

The ownership of the Société Minière de Loulo S.A. (Somilo) was altered when Randgold increased its interest in the joint venture to 51%, with Mine Or, a subsidiary of LaSource of France, retaining 29% equity interest and the Government of Mali keeping 20% equity interest. Somilo was evaluating the development possibilities of the Loulo 0 and the Yalea deposits on the Loulo permit.

A number of companies were active on exploration permits along the western border with Senegal in the area encompassing the Kéniéba gold district and the exploitation permits at Loulo and Sadiola. Exploring the area were Afko Corp. Mali, a subsidiary of Afko Korea Inc.; Sanou Mining Corp., the partnership of Azco Mining Inc. of the United States and West African Gold and Exploration Ltd. of the British Virgin Islands, on the Médinandi and the Dandoko concessions; Echo Bay Mines Ltd. of Canada on the Dag Dag permit; Emerging Africa Gold Inc. of Canada on the Mankouke West, the Koulo, and the Siribaya permits; and International Tournigan Corp. of Canada on the Diangounte West

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property. During 1997, International Tournigan also entered into a joint venture with Société Nationale de Recherches et d'Exploitation des Ressources Minières de Mali (SONAREM) to earn 70% interest in the Kolomba and the Mogoyafara properties. Marchmont Gold Corp., formerly Timbuktu Gold Corp., drilled the Sitakili permit.

Nevsun Resources Ltd. of Canada was studying the Tabakoto and the Kakadian concessions. Oliver Gold Corp. of Canada and Consolidated Mining Corp. (West Africa) of Mali (CMCWA) were negotiating to sell the Segala and the Dar Salam concessions at yearend. Oxford Resources Inc. of Canada was evaluating the Sélou, the Dialafara-Rhama, and the Kéniéba group exploration permits. Pangea Goldfields Inc. of Canada was drilling the Fodié property, north of Sadiola.

In March, African Selection Mining Corp. (ASM) obtained an option to earn 50% of Pan African Resources Corp. of Canada's (PARC) interest in the Dioulafoundou permit. In September, ASM terminated its option. PARC subsequently terminated its interest in the Dioulafoundou property. A sister company of Randgold Resources Mali Inc., Randgold Resources (Mali) Ltd., through subsidiary Randgold Resource Mali S.A.R.L. explored the Kérékoto 1, the Kérékoto 1 Extension, the Kérékoto 2, the Ouiaiga, and the Yanifolila permits. Randgold indicated it would relinquish the Kerekoto 1 and the Ouiaiga permits in 1998. Randgold, through affiliate Dialafara Exploration S.A., continued the evaluation of the Dialafara permit.

Also working in the Kéniéba region were Raymor Resources Ltd. of Canada and Cie. de la Falame S.A. of Mali on the Yeremounde gold property. Raymor also was evaluating the Bogodo gold placer. Ressources Robex Inc. of Canada increased its interest in the Diangounte and the Kata concessions to 85% from 51%. Ressources Robex and N'Gary Transport were drilling on the properties. Ressources Robex (25%) was drilling the Baroya concession for its joint venture partners, Shiega Resources Corp. of Canada, formerly Alpine Exploration Corp. (65%), and SOMEX S.A.R.L. of Mali (10%). Reunion Mining plc of the United Kingdom abandoned the Sanoukou exploration permit it had optioned from SONAREM. Sadiola Exploration Ltd. of the British Virgin Islands (SADEX) was evaluating the Farabakouta zone north of the Sadiola pit in the Sadiola I exploration permit area and the Alamoutala deposit, about 15 km north of Sadiola in the Sadiola II exploration permit. SADEX also acquired the Yatela concession from Eltin Ltd. of Australia and looked at the Niamboulama mineralized zone on Yatela. In 1996, the Korean Institute of Geology, Mining, and Materials had begun mineralogical research in Mali.

Companies evaluating exploration permits in the Kalana, the Kangaba, and the Syama regions south of Bamako included Alagona Trading, Barrick Gold Corp., Mink Mineral Resources Inc. of Canada, Oxford, Pacific Galleon Mining Corp. of Canada, and Pangea Goldfields. Prospex Mining Inc. of the United States was acquiring the Samalofila property from Nearco Jersey (Nominees) Ltd. Randgold ran an aerial geophysical program over the Morila permit, and Sahelian Goldfields Inc. of Canada studied the Kourémalé-Salémalé property. North of Kalana, Young Poong Mining and Construction of Korea was evaluating the Gouenso concession. The Metal Mining Agency of Japan and the Japan International Cooperation Agency contracted to explore the Baoule-Banifing area.

In the northeast, CMCWA and Oliver Gold increased their equity interest in Taghlit S.A. of Mali and Taghlit's Anéfis and In Darset exploration permits.

Diamonds were recovered as byproduct by artisanal gold miners. The Mali Diamond Exploration B.V. joint venture of Ashton West Africa Pty. Ltd. of Australia (51% interest) and Mink Mineral Resources (49%) completed an aeromagnetic survey of their Kéniéba area diamond prospect.

Sodinaf evaluated the development of a spodumene deposit near Boungoini.

Sahelian Oil Ltd. of Canada merged with Malahide Petroleum Corp. of Canada to form Stratic Energy Corp during the year. Stratic reprocessed existing seismic data that covered its three petroleum exploration leases in Mali.

Mali's transportation infrastructure was underdeveloped. The highway network totaled about 15,700 km, mostly in the south. The 1,286-km railroad connecting Bamako with Dakar, Senegal, and the major roads to Côte d'Ivoire were used to import mineral-related products, particularly fuels, as well as equipment and supplies. The gold rush and anticipated development activity will strain Mali's electrical power system. Gold will likely continue to dominate the country's mineral economy with current exploration efforts likely to lead to development of additional gold deposits by the turn of the century.

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TABLE 1
MALI: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Cement, hydraulic		20,000	15,000	13,000	12,000 r/	10,000
Gold, mine output, gold content 3/	kilograms	5,500	6,200	7,800	8,400	19,000
Gypsum		700	500	450	500	100
Iron	kilograms	--	--	69	--	--
Phosphate		2,000	1,039	3,000	-- r/	--
Salt		5,000	5,000	5,000	5,000	5,000
Silver 4/	kilograms	190	200	250	270	800

r/ Revised.
1/ Includes data available through July 1998.
2/ In addition to the commodities listed, Mali produced clays, sand and gravel, and stone for local construction purposes in addition to diamond, marble, and tin, information is inadequate to make reliable estimates of output levels.
3/ Includes estimate of artisanal production.
4/ Estimated silver content of doré bullion.

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THE MINERAL INDUSTRY OF

MAURITANIA

By Bernadette Michalski

Iron ore mining and beneficiation was the dominant mineral industry in Mauritania and has accounted for more than 11% of the gross national product and about 40% of export revenues. Cement, gypsum, plaster, and salt also were produced. The nation's sole petroleum refinery, operating on imported crude oil, supplied most of the country's petroleum product requirements. In mid-1997, the Société Guelb Moghrein d'Akjoujt was approved to redevelop the Akjoujt copper deposit 260 kilometers (km) north of Nouakchott. Gold recovery from the retreatment of the old Akjoujt copper mine tailings ended in early 1996 because of stockpile depletion. Between 1992 and 1996, approximately 5,000 kilograms (kg) of gold was recovered from nearly 2 million metric tons (Mt) of tailings by using a combined ammonia-cyanide leach. Several exploration programs were underway during 1997. Principal activities were focused on diamond exploration in the north; gold exploration in the Tassiast, Tijirit, and Inchiri regions, as well as along the Mali border in the south; and offshore oil exploration.

The Direction des Mines et de la Geologie implements Government policies for developing the mining sector, as well as supervises the semipublic mining companies. Government equity participation in these companies ranges from 40% to 77%.

Mining interests are protected under the Investments Code (1989), the Mining Code of 1977 updated in 1988, and the Petroleum Code (1988).

Production of the nation's foremost mineral commodity, iron ore, was, for the most part, derived from the M'Haoudat Mine, which provided direct shipping ores averaging 65% iron content. *(See table 1.)* Salt is recovered from coastal areas near Nouakchott. Production, however, does not meet the heavy requirements of the fish-processing industry.

Mauritania's iron ore shipments exceeded 11 Mt in 1997. Most exports were delivered to the steel mills of the European Union with Italy and France as the leading importers.

In 1997, the African Export Import Bank opened a renewable $10 million credit line for the purchase of oil from Algeria. Other mineral industry imports included about 125,000 metric tons per year (t/yr) of aluminum and copper semimanufactures, 3,000 t/yr of sulfuric acid, 2,000 t/yr of phosphate fertilizer, and about 12,000 t/yr of salt.

General Gold Resources N.L. of Australia, in partnership with Société Arab des Mines de l'Inchiri, engaged Kvaerner ASA of Norway to oversee the $181 million development program for the Guelb Moghrein copper mine. The 30-month development period includes test work at the mine site to improve cobalt, copper, and gold recovery. A feasibility study by Kilborn SNC-Lavalin of Canada reports a minable reserve of 21.7 Mt averaging 1.81% copper, 1.44 grams per ton (g/t) of gold, and 0.016% cobalt at a copper equivalent cut-off grade of 1.16%. Reserves should support a 14-year mine life at a planned processing rate of 1.5 million metric tons per year (Mt/yr) of sulfide ore and 242,000 t/yr of oxide ore. Exploitation is planned by conventional open pit methods to a depth of 186 meters (m) below surface. Total output from the mine is expected to be 325,000 t of copper, 26,000 kg of gold in the form of doré bars for subsequent refining, and 2,600 t of cobalt in hydroxide powder form for further treatment to recover cobalt metal. Solomon Resources, Ltd., of Canada has made a bid to buy General Gold Resources's Mauritanian properties in 1997. Under the terms of the transaction, General Gold Resources would acquire about 50% interest in Solomon Resources, Ltd., in exchange for transferring its Mauritanian properties to Solomon Resources, Ltd. General Gold Resources will continue to provide all management (General Gold Resources N.L., 1997).

Iron ore mining operations were conducted by Société Nationale Industrielle et Minière (SNIM) in the Tiris Province in northern Mauritania. More than one-half of the more than 11 Mt/yr production is derived from the M'Haoudat deposit, 60 km northeast of Zouirat. As the nation's major mining company, SNIM employed approximately 4,500 workers. In 1997, SNIM entered into agreement with the European Union to finance three projects valued at US$16.4 million. The projects are expected to improve the volume and quality of iron ore exports.

Alexandria National Iron & Steel Co. and Holding Co. for Metallurgical Industries, both of Egypt, along with Enterprise Nationale de Siderurgie and Ferphos, both of Algeria, have joined SNIM in signing a protocol agreement on the construction of an iron ore pelletizing plant to satisfy demands of direct-reduction plants in the region. The plant's capacity was planned at 5 Mt/yr of iron ore pellets upgraded to a 68% iron content from an average of 36% iron content. The project involves mining and beneficiation at Ayouj, 30 km north of F'Derik and 650 km from the port of Nouadhibou.

Rex Diamond Mining Corp. of Canada has obtained two exploration permits, Akchar and El Hammami, covering 46,700 square kilometers (km^2) in northern Mauritania. Within this area, the Taoudeni basin rim was identified as a high-priority area for diamond exploration. An airborne magnetic survey conducted during July through August covered one-half of the basin rim zone, or 100,000 line kilometers. Initial interpretation of the data resulted in the selection of 103 magnetic anomalies, of which 53 have been modeled as pipeline bodies that could be related to diatremes with diameters ranging from 222 to 970 m. Heavy mineral sampling began in October. Mineralogical results showed high kimberlitic pyrope counts on 23% of the heavy mineral samples. Rex Diamond Mining Corp. has applied for a third exploration permit—Tenoumer—covering 25,000 km^2. All three exploration permits cover the core of the Archaean Reguibat craton (Rex Diamond Mining Corp., press release accessed January 16, 1998, at URL http//bix.yahoo.com/prnews/980116/rex_diamon_1.html).

In early 1997, Parliament ratified the 24,645-km^2 petroleum

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exploration permit in the Senegal-Mauritania coastal basin provisionally awarded to Hardman Resources NL of Australia in September 1996. The contract allows for 9 years of exploration in 3-year terms and a 25-year exploitation period plus a 10-year extension. The contract initially calls for acquisition of 500 km of seismic survey data and the drilling of at least one well by September 1999. This was the first active hydrocarbon exploration agreement since 1993 and the first under the new petroleum legislation terms that had been revised by the World Bank in 1994-95. Mauritania's sole petroleum refinery, Nouadhibou, was owned by the Société Mauritanienne d'Industrie de Raffinage and operated under the technical management of Algeria's Nafta. The 20,000-barrel-per-day-capacity refinery, operating on imported crude oil, supplied most of Mauritania's petroleum product requirements.

Mauritania's proven iron ore reserves are 155 Mt of hematite ore ranging from 60% to 68% iron and 531 Mt of magnetite ore ranging from 36% to 40% iron. In addition to these proven reserves, probable iron ore reserves in the western Guelb amount to 980 Mt of low-grade ores. Reserves at the Guelb Moghrein copper mine from surface to 110 m depth are oxide (1.7 Mt averaging 1.94% copper, 2.40 g/t of gold, and 0.031% cobalt), and sulfide (13.7 Mt averaging 1.81% copper, 1.62 g/t of gold, and 0.025% cobalt). Indicated sulfide resources from 110 to 220 m depth at Guelb Moghrein are 10.7 Mt averaging 1.63% copper, and 0.93 g/t of gold; indicated oxide resources are 0.9 Mt averaging 0.82% copper, 1.54 g/t of gold, and 0.016% cobalt (General Gold Resources N.L., 1997).

The nation's limited infrastructure, which renders all but the largest deposits uneconomic, remained a major barrier. There were four paved roads in Mauritania—from the port of Nouakchott to the copper deposits at Akjoujt in the north, from Nouakchott to Nema in the east, from Nouakchott to Rosso in the south, and from Boghe to Kaedi on the southern border. The sole railroad in Mauritania was owned and operated by SNIM for the transport of iron ore from the northern mines to the export terminal. The 1.425-m-standard-guage railroad extends for 704 km from M'Haoudat to the port at Nouadhibo.

In 1997, Mauritania, assisted by the World Bank, was preparing to overhaul its mining sector policies to attract more foreign investment with the objective of diversifying the economic base, increasing employment, and strengthening the technical skills of the labor force. The Ministry of Mines and Industry was revising the mining code and reinforcing and restructuring the state institutions involved in geology and mining. In spite of the nation's heavy external debt burden and significant fiscal balance-of-payments deficits, the existing and planned mining operations suggest an improved outlook for the nation's economy; that is, however, largely dependent on world copper, gold, and iron ore prices.

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TABLE 1
MAURITANIA: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1993	1994	1995	1996	1997 e/
Cement e/	metric tons	111,000 3/	374,000 3/	120,000 r/	120,000	125,000
Gold	kilograms	1,264	1,738	1,196 r/	189	–
Gypsum	metric tons	3,240	4,230	5,810 r/	12,500	12,500
Iron and steel: Iron ore:						
Gross weight	thousand metric tons	9,362	11,400	11,610 r/	11,360	11,700
Iron content e/	do.	5,700	7,000	7,000	7,000	7,000
Petroleum refinery products: e/						
Liquefied petroleum gas	thousand 42-gallon barrels	418 3/	415	439 r/	440 r/	440
Gasoline	do.	1,938 3/	1,925	1,962 r/	1,925	1,925
Kerosene	do.	471 3/	470	479 r/	470	470
Distillate fuel oil	do.	1,099 3/	1,100	1,100	1,100	1,100
Residual fuel oil	do.	2,357 3/	2,355	2,458 r/	2,450 r/	2,450
Other	do.	635 3/	640	700 r/	700	700
Total	do.	6,918 3/	6,905	7,138 r/	7,085 r/	7,085
Salt e/	metric tons	5,500	5,500	5,500	5,500	5,500

e/ Estimated. r/ Revised.
1/ Table includes data available through August 1, 1998.
2/ In addition to the commodities listed, modest quantities of crude construction materials (clays, sand and gravel, and stone) presumably were produced, but output was not reported quantitatively, and available information was inadequate to make reliable estimates of output levels.
3/ Reported figure.

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THE MINERAL INDUSTRY OF

MOROCCO AND WESTERN SAHARA

By Bernadette Michalski

Morocco is the world's third largest producer of phosphate rock, following the United States and China. The nation also has a significant capacity for conversion of phosphate rock into downstream chemicals. Other mineral production includes anthracite coal, antimony, barite, cobalt, copper, fluorspar, iron ore, lead, manganese, salt, silver, and zinc. The mineral industry is Morocco's largest foreign-exchange-earning sector and usually accounts for about 35% of foreign trade and about 6% of the gross domestic product. The mining sector employs 46,600 workers.

Current mining legislation in Morocco is based on Mining Code Bill No. 1-73-412 of August 13, 1973. Regulations concerning the management of petroleum and natural gas resources were revised in 1992 to provide further incentives for international companies. The revised law reduced the Government's share in agreements with international operators from 50% to 35%. Exploration costs are fully deductible for 10 years. Furthermore, the petroleum export duty was waived for the initial 3 years of production. No royalty is payable on the first 4 million metric tons (Mt) (about 30 million barrels) of output from any concession. Maximum total holdings are limited to 10,000 square kilometers (km^2) onshore and 20,000 km^2 offshore for each company. The minimum duration of an agreement was reduced from 15 years to 8 years. Concessionaires are not required to contribute a share of output to domestic needs.

The State's interests in metal and industrial mineral enterprises were represented by the Bureau de Recherches et de Participations Minières (BRPM). Government holdings successfully privatized in 1997 included Société Metallurgique d'Imiter's (SMI) silver mine with BRPM participation reduced from 69% to 13%; the Mohammedia and the Sidi Kacem petroleum refineries with Government equity in each refinery reduced from 100% each to 6.8% and 7.4%, respectfully; and the Société Nationale de Sidérurgie rebar and wire rod plant.

The most pressing environmental issue in Morocco was the pollution of the drinking water supply in the country's two most important river basins, the Sebou and the Qum Er Rabia. Silting of dams and the deterioration of other existing water infrastructure were a major concern. The World Bank, therefore, recommended that investments should be made in repairing existing structures as opposed to financing new projects.

Although Morocco produced a variety of minerals, it is phosphate rock and fertilizers, including phosphoric acid, diammonium phosphate, and triple superphosphate, that remain significant on a global scale. *(See table 1.)*

Morocco is the world's foremost exporter of phosphate rock and phosphoric acid. These commodities account for 70% of the mineral exports, which also include copper, iron ore, lead, and zinc. In 1997, total exports rose by about 10%, from $442 million[1] to $488 million.

Phosphate exports rose by 45%, to $97 million from $67 million. Spain, the United States, and Mexico were the principal phosphate markets by order of volume. Phosphate exports accounted for nearly 31% of Morocco's total exports.

The major mineral commodity imports continued to be crude oil and petroleum products. In 1997, the principal source for imported crude oil was Nigeria and Saudi Arabia. About 900,000 barrels of Iraqi crude oil was purchased during the United Nations-approved Food for Oil Agreement between August and December 1997. The Islamic Development Bank was the source for financing oil imports (Arab Petroleum Research Center, 1998, p. 280). Algeria was the principal source for liquefied petroleum gas. Other imported mineral commodities included sulfur and solid fuels.

The mining industry of Morocco is controlled by the Government, specifically the Directorate of Mines, which is a department in the Ministry of Energy and Mines. The Directorate of Mines is charged with the interpretation and application of the national mining policy. The Directorate also controls the various parastatals and public companies involved in the mining industry. The Directorate of Mines also manages mining properties, labor concerns, commercialization, and studies in mining, mineralogy, and metallurgy.

Established in 1928, BRPM is an autonomous public corporation involved directly or indirectly in the majority of all Moroccan mining enterprises, excluding hydrocarbons and phosphate. BRPM employed about 1,330 people, including 150 engineers. Founded in 1920, the parastatal Office Cherifien des Phosphates (OCP) manages and controls phosphate mining. OCP controls all aspects of the phosphate industry in Morocco, including research, exploitation, and the production of derivative products, such as fertilizers. It employed about 30,000 people, including some 700 engineers and technicians. Created in 1960, La Centrale d'Achat et de Développement de la Région Minière de Tafilalet et de Figuig (CADETAF) promotes the working of artisanal mines of barite, lead, and zinc in the regions of Tafilalet and Figuig. CADETAF provides technical, commercial, and social assistance to the artisanal miners. The Government parastatal that controls hydrocarbon exploration and production is the Office National de Recherches & d'Exploitations Pétrolières.

Since 1993, Omnium Nord Africain (ONA), the largest private company in Morocco, has acquired much of the Government equity offered for privatization. ONA's mining subsidiary, Pole Mines, was involved in seven significant Moroccan mining ventures. Pole Mines' equity ventures included the polymetallic Douar Hajar Mine with Cie. Minière de Guemassa, the Bleida copper mine with Société Minière du Bou Gaffer (SOMIFER), the cobalt mine at Bou Azzer operated by Compagnie de Tifnout Tiranimine (CTT), the El Hammam fluorite mine operated by Société Anonyme d'Entreprises Minières (SAMINE); the Iourim gold mining venture, the silver mine at Imiter operated by SMI with equity ownership by BRPM, and the Guemassa zinc mine.

[1]Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at a rate of DH9.86=US$1.00.

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(See table 2.)

CTT began cobalt recovery from the Bou Azzer mine tailings, which were leached in sulfuric acid, purified with solvent extraction, and then electrowon to produce 99.9% cobalt cathode. The company expects to produce 220 metric tons per year (t/yr) of cobalt cathode from reprocessed tailings. This production is in addition to the 700 tons of cobalt in mine concentrates that is exported to China for refining.

Morocco's leading barite producer, Compagnie Marocaine des Barytes, produces drilling mud grade barite at about 150,000 t/yr from its Zelmau Mine and 80,000 t/yr from Safi. In 1997, the nation's second largest barite producer, Sté Nord Africaine de Recherches et d'Exploitation des Mines d'Argana (SNAREMA), opened a beneficiation plant with the capacity to produce 30,000 t/yr of chemical-grade barite. SNAREMA plans to continue to also produce between 80,000 and 120,000 t/yr of drilling-mud grade barite (Industrial Minerals, 1997).

OCP's Sidi Chennane phosphate rock mine was operational by yearend 1995 and is expected to have a capacity of 5 million metric tons per year by 1998. It will replace older mines now approaching depletion.

Agrupacion Minera de Investigaciones SA has signed an agreement with BRPM to develop zircon-bearing mineral sands and will invest $9.2 million on the development of a deposit near Guelmin on the Atlantic coast (Mining Journal, 1997).

Four petroleum exploration licenses were granted in 1997 for tracts off the Atlantic coast. Royal Dutch acquired a tract offshore Agadir, Taurus Petroleum of Sweden secured a tract offshore Tiznit, Enterprise Oil Exploration of the United Kingdom is exploring the 12,400-km^2 Cap Draa Haute Mer block, and Roc Oil Co. of Australia is licensed to explore the 6,000-km^2 Foum Draa block (Middle East Economic Digest, 1998).

Morocco's crude oil production was negligible, but the domestic consumption rate was steadily rising. Crude oil and petroleum product import costs approached $1 billion per year. Majority holdings in the Mohammedia refinery with a capacity of 129,000 barrels per day (bbl/d) and the Sidi Kacem refinery with a capacity of 26,000 bbl/d were purchased by Corral Petroleum AB for $400 million in 1997. Corral, a Swiss-based Saudi Arabian company, pledged to spend $416 million on renovating and expanding the two refineries. An expansion program raising capacity to 165,000 bbl/d was underway at the Mohammedia refinery and was partially completed when the majority equity was sold (Arab Petroleum Research Center, 1998, p. 278).

In 1997, reserves of phosphate rock totaled 85.5 billion tons; coal, 17.5 Mt; copper, 8.4 Mt; lead, 23 Mt; and zinc, 8 Mt. Crude oil reserves were reported at 1.96 million barrels and natural gas at 1.4 billion cubic meters (Arab Petroleum Research Center, 1998, p. 271).

The railroad network in Morocco totaled 1,893 kilometers (km) of 1.435-meter standard-gauge single track. The highway infrastructure totaled 59,198 km, of which 27,740 km was paved. Crude oil and natural gas pipelines totaled 362 and 241 km, respectively. Morocco's merchant marine fleet comprised 51 ships totaling 487,479 deadweight tons. Of these ships, there were 3 petroleum tankers and 11 chemical tankers. The major Moroccan ports are Agadir, Casablanca, Jorf Lasfar, Kenitra, Mohammedia, Nador, Safi, and Tangier. The nation's electrical generation capacity was 3,700 megawatts.

Morocco has been pursuing an active structural adjustment strategy under the supervision of the International Monetary Fund. A privatization program that began in 1993 with the intention of transferring resources from the public sector to the private sector to promote business investment, to reduce public expenditure, and to improve industrial efficiency had limited success until 1997 when much of the offered equities in the mining industry were purchased by ONA, and petroleum refining and cement manufacturing interests were acquired by foreign investors. The European Union (EU) accord became effective in 1997. The EU has pledged $70 million in grants. Another $70 million was made available as loans from the European Investment Bank. The availability of additional capital through membership in the EU heightened privatization activity.

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TABLE 1
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
METALS						
Antimony concentrate:						
Gross weight		369	523	442	345	–
Sb content		167	235	198	152 e/	–
Cement e/		6,350	6,350	6,400 3/	6,530 3/	6,800
Cobalt concentrate:						
Gross weight		3,606	3,810	4,885	5,033 r/	7,137
Co content		397	419	537	565	722
Cobalt recovered from tailings		–	–	–	80	220 e/
Copper:						
Concentrates, gross weight		35,690	36,010	35,952	37,623	37,344
Matte, gross weight		1,548	1,689	1,933	1,671	2,682
Cu content, concentrates and matte		13,746	14,000	14,100	14,550	15,000 e/
Gold e/	kilograms	600	565 3/	580	482 r/ 3/	450
Iron and steel:						
Iron ore:						
Gross weight		66,318	63,517	47,192	11,842 r/	11,965
Fe content		41,117	39,380	31,518	8,257	8,260 e/
Metal: e/						
Pig iron		15,000	15,000	15,000	15,000	15,000
Steel, crude		7,000	7,000	7,000	7,000	7,000
Lead:						
Concentrate:						
Gross weight		111,896	104,520	101,631	107,577	110,507
Pb content		81,680	73,160	67,708	71,667	77,056
Cupreous matte, Pb content e/		402 3/	442 3/	500	500	500
Metal:						
Smelter, primary only		69,110	60,740	62,363	61,749	66,202
Refined:						
Primary e/		69,100	60,700	59,763 r/ 3/	62,700 r/	64,202 3/
Secondary e/		2,000	2,040 r/	2,600 r/	3,100 r/ 3/	3,000
Total		71,100	62,740 r/	62,363 r/	65,800 r/	67,202
Manganese ore, largely chemical-grade		42,585 r/	31,452	31,263	29,466	28,845
Silver:						
Ag content of concentrates and matte	kilograms	73,355	68,500	22,000	19,304	35,000
Ag content of mine and smelter bullion	do.	235,800	257,000	182,000	180,291	226,000
Total	do.	309,155	325,500	204,000	199,595	261,000
Zinc concentrate:						
Gross weight		125,737	147,213	153,125	152,580	171,796
Zn content		65,378	76,800	79,947 r/	79,662 r/	89,248
INDUSTRIAL MINERALS						
Barite		325,200	264,526	289,308	282,537 r/	338,096
Cement, hydraulic e/	thousand tons	6,350	6,350	6,401 3/	8,000	8,000
Clays, crude:						
Bentonite		10,802	24,919	29,308	39,680 r/	49,633
Fuller's earth (smectite)		38,700	22,800	15,027	17,223 r/	24,425
Montmorillonite (ghassoul)		2,440	3,329	3,311	3,169	2,933
Feldspar		1,000 e/	1,000 e/	17,233	12,659 r/	15,110
Fertilizers	thousand tons	2,600	2,000	2,100	2,200 e/	2,200 e/
Fluorspar, acid-grade		70,050	85,000	105,800	95,900	103,800
Gypsum e/		450,000	450,000	450,000	450,000	450,000
Mica e/		1,500	1,500	564 3/	600	600
Phosphate rock (includes Western Sahara):						
Gross weight	thousand tons	18,305	20,375	20,684	20,855	23,084
P_2O_5 content	do.	5,920	6,580	6,399	6,552	7,848
Phosphoric acid	do.	2,501	2,603	2,600 e/	2,583 r/	2,600 e/
Salt:						
Rock		103,525	142,258	137,910	138,290	210,000 e/
Marine		50,900	45,600	42,300	32,530	47,500 e/
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite		603,800	650,400	649,600	505,600	505,600

See footnotes at end of table.

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TABLE 1--Continued
MOROCCO AND WESTERN SAHARA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
MINERAL FUELS AND RELATED MATERIALS--Continued						
Gas, natural:						
Gross	million cubic meters	38	25	17	17	17 e/
Dry	do.	35	22	16	16	16 e/
Petroleum:						
Crude	thousand 42-gallon barrels	68	62 r/	36 r/	35	35 e/
Refinery products: e/ 4/						
Liquefied petroleum gas	do.	3,250 3/	3,300 3/	3,500	3,500	3,500
Gasoline	do.	3,285 3/	3,300 3/	3,300	3,300	3,300
Jet fuel	do.	2,190 3/	1,900 3/	2,000	2,000	2,000
Kerosene	do.	350 3/	390 3/	390	390	390
Distillate fuel oil	do.	14,435 3/	16,200 3/	16,200	16,200	16,200
Residual fuel oil	do.	17,150 3/	17,200 3/	17,300	17,300	17,300
Other	do.	6,500 3/	7,000 3/	7,000	7,000	7,000
Total	do.	47,160 3/	49,290 3/	49,690	49,690	49,690

e/ Estimated. r/ Revised.

1/ Includes data available through September 15, 1998.

2/ In addition to the commodities listed, a variety of crude construction materials are produced, including, possibly, a substantial amount of limestone; information is, however, inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Refinery fuel and losses have been included in the output of individual products and is estimated to be about 1.8 million barrels per year.

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TABLE 2
MOROCCO AND WESTERN SAHARA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Anthracite	Charbonnages du Maroc (CdM) (Bureau de Recherches et de Participations Minières (BRPM), 98.89%)	Jerada	650,000.
Barite	Compagnie Marocaine des Barytes (COMABAR) (BRPM, 22.5%; Norbar Minerals, 55%)	Zelmou Safi	150,000. 80,000.
Do.	Sté Nord Africaine de Recherches et d'Exploitation des Mines d'Argana (SNAREMA)	Argana do.	30,000 chemical grade. 120,000.
Bentonite	Tolsa, Sp (Tolsa, 100%)	Iboughardain	20,000.
Cement	Asment de Temara (Cimentos de Portugal, 57.4%)	Temara	830,000.
Do.	Lafarge Ciments (Société Nationale d'Investissment, 50%)	Casablanca Meknes Tangier	1,850.000. 1,000,000. 350,000.
Do.	Cimenterie de l'Oriental (CIOR) (Holderbank, 51%; private, 35%)	Oujda Fes	1,000,000. 700,000.
Cobalt	Compagnie de Tifnout Tiranimine (CTT) (Omnium Nord Africain (ONA), 55.2%; SMI, 20%)	Bou Azzer	150,000 ore. 50,000 concentrate.
Copper	Société Minière de Bou Gaffer (SOMIFER) (BRPM, 34.2%, SMI, 36%; ONA, 7.6%)	Bleida	50,000 concentrate.
Do.	Société de Développement du Cuivre de l'Anti-Atlas (SODECAT) (BRPM, 100%)	Tiouit	4,500 Cu, Au, Ag concentrate.
Fluorspar	Société Anonyme d'Entreprises Minières (SAMINE) (ONA, 58%; SMI, 42%)	Meknes	120,000 concentrate.
Gold	Akka Gold Mining (ONA, 70%; BRPM, 30%)	Iourim	NA
Iron ore million metric tons	Société d'Exploitation des Mines du Rif (SEFERIF) (BRPM, 100%)	Nador	12.
Lead	Compagnie Minière de Guemassa (CMG) (ONA, 74%; BRPM, 26%)	Hajar	150,000 Zn concentrate, 32,000 Pb concentrate.
Do.	Compagnie Minière de Touissit (CMT) (50% Compagnie Royale Asturienne des Mines S.A., Belgium)	Touissit	73,000 concentrate.
Do.	Société de Développement Industrien et Minière (BRPM, 50%)	Zeida	40,000 concentrate.
Manganese	Société Anonyme Chérifienne d 'Etudes Minières (SACEM) (BRPM, 43%; COMILOG, 30%)	Quarzazate	130,000 concentrate.
Petroleum refinery products thousand 42 gallon barrels	Société Marocaine de l'Industrie du Raffinage (Government, 6.77%; Corral Petroleum AB, 92%)	Mohammedia	47,000.
Do. do.	Société Chérifienne des Pétroles (SCP) (Government, 7.39%; Corral Petroleum AB, 91%)	Sidi Kacem	9,500.
Phosphate million metric tons	Office Chérifien des Phosphates (OCP) (Government, 100%)	Youssoufia, Benguerir Khouribga Sidi Chenan BouCraa	6 concentrate. 6 concentrate. 4 concentrate. 5 concentrate. 6 concentrate.
Salt, rock	Société de Sel de Mohammedia (SSM) (BRPM, 100%)	Mohammedia	150,000.
Salt, marine	Société Chérifienne des Sels (SCS) (BRPM, 50%; SNSSS, 50%)	Zima	50,000.
Silver kilograms	Société Metallurgique d'Imiter (SMI) (ONA, 67%; private, 20%; BRPM, 13%)	Near Quarzazate	210,000
Steel rebar, wire rod	Société Nationale de Sidérurgie (SONASID) (private, 65%)	Nador	480,000.
Zinc	Omnium Nord Africain mine and plant (ONA, 100%)	Guemassa	265,000 concentrate.
Zircon	Agrupacion Minera de Investigaciones SA	Guelmin	NA

NA Not available.

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THE MINERAL INDUSTRY OF

MOZAMBIQUE

By George J. Coakley

The Republic of Mozambique is located on the southeast coast of Africa and has an area of 749,090 square kilometers (km^2). In 1997, the area supported a population of 18.2 million and a gross domestic product (GDP) per capita, based on purchasing power parity estimates in 1995, of $670. Following nearly 30 years of fighting prior to gaining independence from Portugal in 1974 and then resolving a prolonged internal civil war, 1994 finally brought peace and a freely elected Government to Mozambique. In 1997, the economy began to show the turnaround hoped for under the rigorous International Monetary Fund and World Bank structural adjustment program began in the late 1980's—the GDP grew by 14%, inflation was a single digit, and export trade increased. The country's high foreign debt load, however, remained a problem. The minerals and energy sectors played secondary roles to agriculture and fishing in the economy but were the targets for several major new foreign investment proposals. Efforts to rebuild the economy have placed major emphases on mineral-resource development and regional economic integration. Nearly $12 billion in new mineral and infrastructure development projects were being considered by Government and private foreign investors in 1997. Priority also continued to be given to the removal of land mines around the major transportation routes and population centers. Development plans to date depend heavily on the energy potential of the underutilized Cabora Bassa hydroelectric dam; the Pande, the Temane, and the Buzi natural gas fields; and the coal resources at Moatize; and on modernization of the Indian Ocean export harbors at Beira, Maputo-Matola, and Nacala and associated transportation infrastructure. In the metals sector, studies were underway to determine the feasibility of developing major aluminum, iron, and titanium projects. Resources of dimension stone, gemstones, gold, niobium, petroleum, phosphates, rare-earth minerals, and tantalum were also known (Mozambique Ministry of Mineral Resources and Energy, 1995). Mozambique continued to be an important source of labor for the South African gold industry, with about 60,000 Mozambican miners employed in Witswatersrand gold mines. Repatriated wages from this workforce provided a significant contribution to the Mozambican economy.

The national mining and petroleum policy is directed at promoting foreign investment and exports, thus increasing the supply of raw materials for domestic industries and minimizing direct government participation in mineral activities. The minerals industry is regulated by the Mining law No. 2/86 of April 16, 1986, as amended by law 5/94 of September 18, 1994, and by the Mining Law Regulations (Decree 13/87 of February 24, 1987). The Mining law is administered by the Minister of Mineral Resources and Energy through the National Directorate for Mines. Tax and other fiscal matters for the mining sector are regulated by the Mining Tax Code (Decree 53/94 of November 9, 1994). Petroleum rights and licensing are regulated by the Petroleum law (Decree No. 3/81) of 1981. Under this law, the national oil company, Empresa Nacional de Hidrocarbonetos (ENH), has statutory responsibility for the exploration and development of natural gas and petroleum resources and can enter into joint ventures and other forms of contractual relations with private companies. Petroleum licensing usually takes the form of a production-sharing agreement with ENH, and natural gas exploration and development takes the form of profit-sharing joint ventures.

The mining industry was chiefly noted for its production and export of bauxite, bentonite, gemstones, graphite, and marble. In addition to these minerals, small quantities of gold along with some industrial mineral commodities, including cement, marine salt, and sand and gravel, were produced. Mineral commodity production, as reported by the Ministry of Mineral Resources, and Energy, is shown in table 1. Official exports were dominated by bauxite, gemstones, graphite, and marble.

Billiton Plc's South African subsidiary, Alusaf, Ltd., in partnership with Industrial Development Corp. (IDC) of South Africa, has formed the Mozambique Aluminum Co. (Mozal). Billiton is the United Kingdom-based, offshore arm of Gencor Ltd. of South Africa. Following completion of a $5 million feasibility study, Billiton announced plans to develop a 245,000-metric-ton-per-year (t/yr) aluminum smelter 17 kilometers (km) west of Maputo. Construction is expected to begin near mid-1998 and to be completed by yearend 2000. Feedstock for the smelter will be source from Billiton-owned alumina plants in Australia, Brazil, and Suriname. The company was targeting a 50-50 debt-to-equity ratio to finance the $1.2 billion project. Additional American, Brazilian, or Japanese investors were being sought. Provision has been made at the site to double capacity size to 490,000 metric tons (t) in the future. An engineering, procurement, and construction management contract has been awarded to the joint venture company comprising SNC Lavalin of Canada and Murray and Roberts Engineering Management Services of South Africa. This is the same group that recently built the 466,000-t/yr Alusaf aluminum smelter in Richards Bay, South Africa. The Government approved an environmental impact assessment of the project conducted by the Council for Scientific and Industrial Research of South Africa, the Mozambique Ministry of Environmental Affairs, and the World Bank. The competitive position of the Mozal smelter has been aided by an electricity tariff agreement between the South African power company, Eskom, and the Mozambique electricity supply authority and by the granting of a tax-free industrial zone status to the project by the Mozambican Government. The tariff agreement will allow power

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sharing between South African coal-based electricity and Mozambican hydroelectric-based power, with power costs to Mozal linked to the world market price for aluminum. The project is expected to be a major stimulus to economic development in Mozambique by creating 5,300 construction jobs and 2,600 permanent smelter and related service jobs, bringing in more than $430 million in foreign exchange earnings per year and expanding road, port handling, and new hydropower infrastructure capacities (Mining Journal, 1997; U.S. Embassy, Pretoria, South Africa, 1997; African Mining, 1998a).

A number of Canadian companies, including Greenhope Resources Inc. and Trillion Resources Ltd., at the Muende, the Chifunde, the Chifumbazi, the Chicamba, the Chimeze, and the Zambuzi properties; the joint-venture partners, Harambee Mining Corp. and Tan Range Exploration Corp., on the Chowalo and the Machinga gold concessions in the Archean greenstone belts of northwestern Mozambique; and Adamas Resources Corp. on the Niassa concession were actively exploring for gold during the year. Other companies active in the country included Anglo American Corp., Gencor and Lonrho Corp. of the United Kingdom, Ashanti Goldfields of Ghana, and Broken Hill Proprietary Ltd. (BHP) of Australia.

JCI Ltd. and IDC were considering development of a $660 million, 2.5-million-metric-ton-per-year (Mt/yr), hot briqueted iron (HBI) ore plant near the port of Beira. The plant would use iron ore from Brazil and low-cost gas from the Temane or the Buzi-Divinhe natural gas fields south of Beira. JCI has secured options, at less than $0.75 a gigajoule, on the Temane gas with Atlantic Richfield Co. (Arco) of the United States and Sasol of South Africa and on the Buzi gas with the two Canadian companies holding the production-sharing agreement with ENH, Leopardus Resources Ltd. and Scimitar Hydrocarbons Corp. Leopardus also has corporate ties with the Bin Ham Oil Group of the United Arab Emirates. JCI holds a 52% interest in the HBI project, and the Mozambican Government holds 20%; the Zimbabwean Government, 3%; and others, 25% (Reuters News, August 13, 1997, Mozambique iron plant vital for JCI future, accessed August 8, 1998, at URL http://www.leopardus.com/related_stories5.html). Feasibility studies for the project will also look at the potential impact of high carbon dioxide emissions from the proposed plant on nearby prawn fishing and on air quality (Josey Ballenger, February 5, 1998, Business Day (Johannesburg)—Iron project talks to be held in Beira, accessed February 9, 1998, at URL http://bday.co.za/cgi-bin/post-query.perl). High-quality iron ore near Mutare, Zimbabwe, with a resource estimated to range from 100 million to 200 million metric tons (Mt), could become an alternative source of iron ore for the project within the next 5 to 8 years. A decision to proceed with the project was expected to be made in March 1998 (Ruffini, 1998b), with project completion targeted for 2001.

IDC is examining the feasibility of combining Pande gas with hematite ore from Sishen, South Africa, and from 270 Mt of stockpiled byproduct titaniferous magnetite ore from the Palabora copper mine, also in South Africa, to build a $1billion 4-Mt/yr direct-reduced-iron plant near Maputo. Construction of an adjacent 3.4-Mt/yr slab steel plant is also being considered by IDC. Mitsui & Co. Ltd. of Japan and the Swiss steel trader, Duferco Group, were reported to be possible equity partners in the $2 billion project with IDC and Enron Development Corp. of the United States. The proposed project feasibility study prepared by Enron will be evaluated by the National Directorate for Coal and Hydrocarbons in early 1998. Arrangements for project financing were pending approval by the Government. The project would take 42 months to build and generate about $750 million in annual revenues. It would include construction of a 700-km pipeline from the Pande gas field to the capital city of Maputo and of a slurry pipeline for the magnetite ore from Phalaborwa, South Africa, under or around the Kruger National Game Park, which will raise additional environmental concerns in South Africa. (Metal Bulletin, 1998; Simon Barber and Fernando Lima, December 29, 1997, Business Day (Johannesburg)—Enron, IDC hand iron and steel plant blueprint to Mozambican government, accessed January 7, 1998, at URL http://bday.co.za/cgi-bin/post-query.perl).

Harmony Gold Mining Co. of South Africa was developing a tantalum deposit at Morrua in Zambezia Province. Reserves were estimated to be 4.4 Mt containing 5.6% tantalum oxide from which 1,700 t of tantalum oxide could be recovered. An open-pit mine producing 450,000 t/yr of ore was planned (Mbendi Information Services, 1998, Mozambique—Mineral sands and the rare-earths mining, accessed August 12, 1998, at URL http://mbendi.co.za/indy/ming/mingmzot.htm).

The Government-owned Companhia de Desenvovimento Mineiro was actively pursuing exploration and development opportunities at the Boane bentonite deposit in Maputo Province, rare earths and tantalum prospects at Morrua with Grupo Madal s.a.r.l., and the tantalum, kaolin, and rare-earth deposits in Muiane, Zambezia Province, with African Mining and Trust Pty. Ltd. of South Africa.

In titanium developments, three separate projects were under investigation. Billiton conducted a $3.9 million first-phase prefeasibility study in 1997 to examine the technical merits of developing the TiGen mineral sands project at Moebase, Zambezia Province, 500 km north of Beira. Exploration results reported in Gencor's 1996 annual report indicated a resource in excess of 1 billion tons of sand containing some 4% heavy minerals. The contained titanium dioxide content is approximately 22 Mt. Ilmenite ore would be treated to produce 400,000 tons per year (t/yr) of titania slag at a plant at the port city of Nacala at a cost of $500 million by 1999-2000. A source of power supply for the plant remained a problem. Billiton holds a 100% interest in the project after acquiring the remaining minority equity interests of Edlow Resources of Bermuda in December 1996 (Gencor, 1997). The joint venture between BHP International Minerals of Australia and Kenmare Resources Plc. of Ireland planned to invest more than $300 million to develop the Congolone titaniferous sands concession near Angoche/Quinga, Nampula Province. The Congolone project would produce 35,000 t/yr of zircon, 418,000 t/yr of ilmenite, and 8,000 t/yr of rutile by 2000. During 1997, exploration increased the total resource of contained ilmenite at Congolone to 58 Mt with a titanium dioxide content of 52% to 55%. BHP will earn a 75% interest in the project following their expenditure of $24 million on exploration and feasibility studies. The titanium project in the Limpopo River delta just north of Xai-

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Xai, was being undertaken by Aquater S.p.A. of Italy, which spent $3 million on exploration of the deltaic and inland extensions of the deposit in 1997 (African Mining, 1998b).

Stimulated by major infrastructure development projects, consumption of cement has been on the rise, increasing to 230,000 t in 1996. The country's sole producer, Cimentos de Mocambique, controlled by Cimpor of Portugal (51%) and by the Government (48%), had an annual capacity of around 100,000 t in 1996. Cimentos de Mocambique had initiated a 10-year, $96 million program to upgrade its plants at Dondo, Matola, and Nacala and to increase capacity to 850,000 t/yr (International Cement Review, 1997).

The Ancuabe graphite mine north of Montepuez has been in production since July 1995. The operating company was Grafites de Ancuabe s.a.r.l., a joint venture among Kenmare, the Government of Mozambique, and the United Kingdom's Commonwealth Development Corp. Kenmare increased its equity control of the company from 65% to 77% in 1997. The mine's plant capacity for coarse flake graphite concentrate grading more than 98% carbon was being expanded from 7,500 to 10,000 t/yr (Industrial Minerals, 1997). Most of the production is exported to Canada, Germany, Japan, and the United States for the production of refractories. Development of the Ancuabe mine was based on 24 Mt of ore reserves grading from 3% to 11% graphite identified during pre-1995 exploration.

The Government has given a development priority to reopening the Moatize coal mine in Tete Province. The mines, which have been essentially inoperable for almost 10 years, were once the country's major export earner. Exploration by Companhia Vale do Rio Doce (CVRD) of Brazil and others in the 1980's and early 1990's identified coal resources of 15.8 billion tons in the Karroo sediments of Tete Province. Of the total proven coal reserves in the country of 2.28 Mt, 1.8 Mt of low-sulfur, high ash, bituminous coking coal reserves are located in the Moatize coal field (Ruffini, 1998a). In January 1997, the Government gave JCI an option to lead the development of Moatize. Negotiations were still underway at yearend to form a consortium, including JCI and Austral Coal Ltd. of Australia, to finance the $480 million redevelopment of the Moatize Mine. In addition to the mine development, plans call for a $30 million upgrade of the harbor at Nacala to permit the export of 3.2 Mt/yr of coking coal and a $300 million rehabilitation of the Moatize to Beira railroad (Business Day Online (Johannesburg), February 2, 1997, Mozambique plans to revive Moatize coal mines, accessed August 14, 1998, at URL http://www.bday.co.za/97/0228/world/w7.htm). JCI planned to export the bulk of the coal to Brazil on the return run of ore freighters bringing in CVRD iron ore for JCI's HBI plant at Beira. Reopening of the railroad will immediately permit the export of more than 200,000 t of coal stockpiled at the mine. JCI was also considering building a $1 billion thermal powerplant that would use Moatize residual steam coal at the Beira or the Nacala harbor. In other coal developments, African Portland Industrial Holdings of Namibia acquired a 95% interest in the Matola coal terminal in Maputo Harbor.

The foreign investment interest in the petroleum and natural gas sectors has been primarily for natural gas with three major gasfields, Buzi-Divinhe, Pande, and Temane being considered for development. There are no known oilfields. Enron held an exclusive production-sharing agreement with ENH to invest at least $1 billion to develop the estimated 85 billion cubic meters of reserves in the Pande gasfield and associated pipelines needed to feed other industrial projects. The agreement was subject to Enron's ability to arrange project financing, which was also tied to proposed new iron and steel projects at Maputo. Financing and gas marketing arrangements for the Pande gas project were still pending at yearend 1997 (Indian Ocean Newsletter, 1998). Arco held the rights to the estimated 17 billion cubic meters of proven natural gas reserves at the Temane field south of Pande along with an offshore block of the coast of Sofala Province. Arco was negotiating a potential gas marketing agreement with JCI and Sasol Petroleum International (Pty.) Ltd., the latter for its Secunda synfuels plant in South Africa.

Scimitar Production International Ltd. of Canada and joint contractor Leopardus Resources of Canada, which have corporate ties to Zarara Petroleum Resources Ltd. and Bin Ham Oil Group of the United Arab Emirates held the rights from ENH to exploit the known gas resources of the Temane and the Buzi-Divinhe gas permit areas and to explore the Sofala and the M-10 offshore permit areas. On the basis of existing geologic and geophysical data, Leopardus reported reserves of 14 billion to 140 billion cubic meters of natural gas at Buzi-Divinhe and in excess of 51 billion cubic meters of gas at Temane (Leopardus Resources Ltd., 1998, Overview of the company, accessed August 8, 1998, at URL http://www.leopardus.com/over.html). In June 1997, Leopardus and Scimitar signed a $500,000 agreement with JCI giving JCI the option to purchase 34 billion cubic meters of Buzi gas during a 30-year period. Leopardus has also been given access to a 100-km^2 tax-free zone at Beira to attract additional industrial development and financing for the Buzi gas project. Leopardus was to acquire Zarara's rights to the Temane gasfield in February 1998 along with their 4.76% development interest. Arco and Sasol each held a 47.62% interest in Temane. Arco will be the initial operator, with Sasol taking over after 5 or 6 years. Other companies actively exploring for natural gas and oil included British Petroleum, Lonrho Ltd. of the United Kingdom, and Norbay Oil of Norway.

Because the country's infrastructure suffered major damage and neglect during the prolonged war years, infrastructure development projects have been given a major priority. Spinoffs from the Mozal aluminum smelter project will include completion of high-voltage transmission lines between the Cabora Bassa hydroelectric dam and South Africa; construction of the new $1.5 billion 2,500-megawatt (MW) Mepanda Uncua hydroelectric dam on the Zambezi River and an associated $500 million 1,500-km transmission line to Maputo; and renovation of Maputo Harbor to handle up to 10 Mt/yr of cargo, 800,000 t of which will be dedicated to Mozal aluminum project imports and exports. The joint Mozambique-South African Maputo Corridor Project between Johannesburg and Maputo will upgrade 500 km of road and rail links and dredge and improve Maputo Harbor to stimulate agricultural, industrial, and tourism development projects in both countries. The Maputo Corridor Project is expected to cost more than $1 billion with 90% of financing coming from the private sector. Construction contracts were to be issued in 1998 (Richard

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Meares, August 1, 1997, Reuters—Maputo Corridor boosted by smelters, ministers say, accessed August 1, 1997, at URL http://biz.yahoo.com/finance/97/08/01/gcor_y000_1.htm). To accommodate the HBI project, the port at Beira will be upgraded to handle 250,000-t ships with a 4-km-long pier. The continuing dispute between the Portuguese and the Mozambique Governments on the repayment of the $3.2 billion debt on the Cabora Bassa hydroelectric dam, which was built during Portuguese rule, could impact power swapping agreements with Eskom, if increased tariffs to Eskom are imposed (Business Day Online (Johannesburg), January 8, 1998, Eskom seeks to settle power dispute through talks, accessed August 12, 1998, at URL http://www.bday.co.za/cgi-bin/post-query.perl). Eskom had rights to purchase the full 2,000-MW capacity of the dam, which has been inoperable since 1982. The Cabora Bassa hydroelectric plant is expected to be operational again around mid-1998. Also during 1997, as part of a Zambezi Valley development study, Portugal provided $700,000 to finance a study on the feasibility of increasing the capacity of Cabora Bassa capacity to 3,200 MW (Indian Ocean Newsletter, 1997).

The Mozambican economy appeared to be poised to undergo a major recovery based substantially on proposed new energy- and mineral-related investment and export-oriented industrial development. Although the outlook is optimistic, the full realization of the nearly $12 billion in new investment is still contingent on several political and market factors. These include continued internal political stability and external regional cooperation, especially with neighbors, South Africa and Zimbabwe; continued positive market conditions for aluminum, coal, iron and steel, and titanium; and the ability of project management to attract the necessary development capital in competition with similar projects elsewhere in the world. The country's strong coal, gas, and hydroelectric energy base, however, remained a strong magnet for attracting the needed capital and industrial development.

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TABLE 1
MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Bauxite		6,000	9,620	10,700	11,459 r/	10,700 3/
Cement, hydraulic e/	thousand tons	20	60 r/	60 r/	100 r/	200
Clays, bentonite		100 e/	3,350	3,500	11,051 r/	13,799 3/
Coal, bituminous		48,400	58,190	40,000 r/	40,000 r/ e/	30,000
Copper: concentrate:						
Gross weight		--	1,240	--	--	--
Cu content e/		--	259	--	--	--
Gemstones, semiprecious:						
Cut stones, all types	carats	7,690	6,450	6,000	2,663 r/	5,457 3/
Rough stones e/ 4/	kilograms	560	7,000	8,000	1,862 r/	1,084 3/
Gold 5/	do.	149	6,804	6,800	67 r/	100 3/
Graphite, concentrates		10	430	3,019 r/	3,283 r/	5,125 3/
Marble:						
Block	cubic meters	1,380	1,500	1,500	744 r/	252 3/
Slab	square meters	34	52,300	52,300	18,232 r/	16,767 3/
Salt, marine e/		35,000	40,000	40,000	60,000	60,000

e/ Estimated. r/ Revised.

1/ Data available through July 31, 1998.

2/ In addition to the commodities listed, construction materials (other clays, sand and gravel, and stone) are produced, as is a small quantity of natura For these commodities, output is not reported quantitatively, and information is insufficient to make reliable estimates.

3/ Reported data.

4/ Artisanal production of rough gemstones include, in order of importance, tourmaline, garnet, dumortierite, aquamarine, emerald, and morganite.

5/ Does not include artisanal gold, for which there were no data, but for which the Government has estimated about 4,000 kilograms per year.

TABLE 2
MOZAMBIQUE: RESERVE BASE OF MAJOR MINERALS

(Million metric tons unless otherwise specified)

Commodity		Reserve base
Apatite		274
Asbestos	thousand tons	500
Bauxite		6.13
Bentonite		8.5
Coal		9,750
Copper	thousand tons	382
Diatomite		3
Feldspar	thousand tons	12
Fluorite		1.5
Gold	thousand tons	47
Graphite		40
Gypsum		40.2
Iron ore		254
Kaolin		4.4
Limestone		40
Marble	million cubic meters	30
Natural gas	billion cubic meters	122
Nepheline syenite		4,300
Perlite	thousand tons	945
Tantalite		7.5
Titanium ore		348

Source: Mozambique Ministry of Mineral Resources, Mineral Resources Development and Investment Opportunities, 1995, p. 21-22.

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THE MINERAL INDUSTRY OF

NAMIBIA

By George J. Coakley

Namibia is located on the southwest coast of Africa between South Africa and Angola. The 825,418-square-kilometer country had an estimated population in 1997 of 1.63 million and a gross domestic product (GDP) per capita of about $2,070. The mineral industry of Namibia provided about 15% of the country's $3.2 billion[1] GDP in 1996 (iafrica.com Namibia, [no date] General information—GDP figures; accessed October 1, 1998, at URL http://trade.iafrica.com.na/generalinfo/factsfigures/composition.htm) and annually contributes to approximately 50% of the value of total exports earnings. In 1997, the industry was dominated by three established mining companies—Namdeb Diamond Corp (Pty.) Ltd., Rossing Uranium Ltd., and Tsumeb Corp. Ltd. The Government's proactive policies encouraged new entrants in copper, diamond, natural gas, and zinc.

Encouraged by a favorable investment environment and the supporting technical resource assessment work of the Geological Survey of Namibia, more than 40 mines were in operation and more than 60 companies were actively exploring in 1996 and 1997 (Mining Journal, 1997). A number of Australian and Canadian companies, predominately exploring for diamond and gold, augmented local prospecting activities. During 1997, 338 nonexclusive prospecting licenses, down by 31% from 1996; 121 exclusive prospecting licenses (an increase of 128%), and 74 mining claims (down 53%) were issued by the Mining Commissioner's Office in the Ministry of Mines and Energy. The Chamber of Mines reported exploration expenditures from about 40 member companies of $21 million in 1997 compared with $27.6 million (Chamber of Mines of Namibia, 1998). Marine diamonds continued to be the main focus of exploration with Ocean Diamond Mining Holdings (ODM) starting up offshore production in 1997 and with Namibian Minerals Corp. (Namco) expected to move into production in early 1998. The Haib copper and the Scorpion zinc projects were also progressing toward development.

Government Policies and Programs

The basic mining law is the Minerals (Prospecting and Mining) Act, No. 33 of 1992, which took effect on April 1, 1994. An accompanying Mining (Taxation) Act set forth revised fiscal and royalty provisions for the industry. The Mining Act was still being refined and additional amendments were expected in 1998. The Chamber of Mines of Namibia outlined the mining tax environment in a late 1995 promotional publication (Chamber of Mines of Namibia, 1995).

The system of taxation on diamond mining consisted of three separate taxes—income, diamond profits, and diamond export duties. The latter has now been replaced by a 10% royalty. The overall income tax on diamond mining companies is levied at the rate of 55% of taxable income, plus a surcharge of 10% on the market value of diamonds shipped and sold. The Income Tax Act provides that this 10% surcharge paid as diamond profits tax be credited against the income tax payable by diamond mines. A new Diamond Act is expected to be promulgated in 1998.

The fiscal regime for oil exploration companies consists of three principal elements—an income tax and an Additional Profits Tax (APT), both levied in terms of the Petroleum (Taxation) Act, No. 3 of 1991; and a 12.5% royalty, levied in terms of the Petroleum (Exploration and Production) Act, No. 2 of 1991. In October 1997, in preparation for the Third Petroleum Licensing Round, which will be open between October 1, 1998, and March 31, 1999, the Namibian Government amended the 1991 Petroleum (Exploration & Production) Act, No. 2; the 1991 Petroleum (Taxation) Act; and the Model Petroleum Agreement to provide additional incentives to attract new foreign investment. These include, among others, options to extend the exploration period and lowering the production royalties from 12.5% to 5%, the petroleum income tax from 42% to 35%, and the additional profits tax to 25% (Abraham, 1998).

The Foreign Investment Act of 1990 offers prospective investors a package of incentives, such as repatriation of profits, security of title and tenure, availability of foreign exchange, international arbitration, and fair compensation in case of expropriation.

The Ministry of Mines and Energy is responsible for making and enforcing policies related to minerals and energy. Within the ministry and attached to the Permanent Secretary are the Diamond Board, the Mining Advisory Board, and the National Energy Council, all of which have Government and private sector representation. The Namibia Petroleum Co. (NAMCOR), and the Namibia national electric utility, NamPower, also are part of the ministry. The four main directorates in the ministry are the Geological Survey, Mining, Energy, and Administration and Finance. The three main functions of the Mining Directorate are evaluating and controlling mineral license applications, ensuring adequate safety standards in mining operations, and collecting, analyzing, and disseminating production statistics. An Ancillary Rights Commission was set up by the Ministry to handle dispute arbitration.

The Government also is empowered to review exploration licenses issued under the previous mining law to determine if the holders of the licenses are actually conducting exploration activities. If the Government determines that insufficient work is being done, then it can revoke the license and reissue the license to another company. The license review was expected to free up considerable land area for exploration, previously locked up by the practice of "ringfencing" of claims. The Government was also working on new draft Mine Safety Regulations and a draft White

[1] Where necessary, values have been converted from the Namibian dollar (ND) to U.S. dollars at the rate of N$4.61=US$1.00 for 1997 and N$4.29=US$1.00 for 1996.

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Paper on a National Energy Policy during 1997.

Environmental Issues

As one of the major sectors of the economy, the mining industry plays an active role in funding conservation awareness and environmental education programs. Some of Namibia's mines are located in or close to one of the world's oldest deserts, the Namib, which is host to a number of extremely rare species of plant and animal life. Because this unique habitat is one of Namibia's most valuable tourist assets, the ecosystem is closely monitored by the local and international scientific and conservation communities. The competition for limited water resources between human and industrial uses will remain an ongoing environmental concern for the country.

In addition to the desert, Namibia possesses several "wetland" areas of international repute, particularly the Etosha Salt Pan, the Kavango/Caprivi region, the Walvis Bay lagoon, and Sandwich Harbor, as well as the mouths of the Orange and the Kunene Rivers. The fragile nature of these desert and wetland ecosystems must be taken into account during the consideration of any infrastructure projects, such as railroads or pipelines, between Walvis Bay and northeastern Namibia and Botswana. Comprehensive studies have been undertaken to assess the effects of marine mining operations with respect to these areas and, in particular, the changes in tidal patterns caused by the disposal of fine sediments during offshore mining. In addition, work is being carried out to assess the extent of any interaction between marine mining activities and the local fishing (mainly lobster) and mariculture (oyster and mussel production) industries and to provide information that will assist these industries to develop and coexist with minimal adverse effects upon each other.

Production and Trade

The production statistics in table 1 were compiled mostly from data provided by the Namibia Ministry of Mines and Energy in response to the U.S. Geological Survey's annual minerals questionnaire and from Chamber of Mines and company reports. Production of mineral commodities generally declined in Namibia in 1997 compared with that of 1996. Copper, diamond, salt, semiprecious stones, uranium, and zinc production were all up, and declines in lead mine and copper and lead smelter production were attributed to the closure of the Tsumeb Mine and problems with the startup of the new Ausmelt lead smelter. The declines in fluorspar and manganese production in 1997 were attributed to metallurgical problems and weak steel markets, respectively.

The latest available trade data showed that ores and minerals accounted for 51.2% of the value of total exports of $1.43 billion in 1995 compared with 49.4% of the value of total exports of $1.34 billion in 1994 (Africa Trade and Business Bulletin, 1998, Namibia business and investment information, Imports and Exports Sections, accessed February 10, 1998, at URL http://www.bizafrica. com [Note: Internet site cited superseded by commercial site http://www.bizeurope.com/bsr/country/Africa.htm]. In 1995, diamond, which were approximately 96% gem quality, were the major mineral export valued at $485 million, followed by gold at $70 million, combined lead-zinc-silver exports at $36 million and all others, including uranium, valued at $113 million. Available breakouts on 1994 total imports of $1.4 billion showed that mineral fuels and lubricants accounted for $144 million and metals and metal products, $72 million. The general trade pattern was likely the same in 1996 and 1997, with a nominal increase in the value of diamond exports and a decline in the value of copper and lead exports.

During 1997, the Chamber of Mines of Namibia membership consisted of 41 mining and exploration companies and 23 associated service representatives compared with 38 and 15 members respectively, in 1996. The 10 largest companies employed more than 8,100 workers in 1997; Namdeb accounting for more than 3,500. The majority of mining companies in Namibia were owned privately, whereas Government participation in mining remained limited as shown in table 2.

Commodity Review

Metals

Copper-Lead-Zinc.—Tsumeb, a subsidiary of Gold Fields Namibia Ltd. of South Africa, produced copper from the retreatment of Tsumeb mine tailings and from the Khusib Springs, the Kombat, and the Otjihase Mines. Flooding, which shut down the Kombat Mine for nearly 2 months; poor recovery of copper and lead from tailings; and underground problems at the Otjihase Mine led to substantial operating losses during the year and forced Tsumeb to purchase 32% of the copper concentrates supplied to their captive smelter (Gold Fields Namibia Ltd., October 16, 1997, Smelter problems impact on Gold Fields Namibia, press release, accessed October 27, 1997, at URL http://www.goldfields.co.za/971016/Gfnsep.htp). For calendar year 1997, Gold Fields Namibia milled 811,000 metric tons (t) of mined ore plus 991,999 t of retreated tailings, yielding concentrates containing 11,548 t of copper, 5,089 t of lead, and 43,031 kilograms (kg) of silver. The Tsumeb smelters produced 22,042 t of blister copper and 1,242 t of refined lead. The breakout of concentrate production included 5,340 t of copper and 6,282 t of lead concentrates from Tsumeb tailings; 18,959 t of copper and 6,282 t of lead from the Kombat Mine; 21,473 t of copper from the Khusib Springs Mine; and 26,283 of copper and 93,684 t of pyrite concentrates from the Otjihase Mine. A decision was made to suspend operations at the tailings retreatment facility and at the Ausmelt lead smelter at yearend for further metallurgical test work. The Ausmelt smelter had been shut down in August owing to technical problems requiring a relining of the refractory furnace and adjustments to the gas cooling system and tap holes. The smelter was originally designed to handle 100,000 tons per year (t/yr) of lead concentrates to produce 24,000 t/yr of lead bullion. Gold Fields reported strike related losses of $7 million in 1996 and further operating losses of nearly $12 million in 1997. With no advance notice to employees, the Mineworkers Union of Namibia, or the Government, Gold Fields Namibia closed down all mining and smelting operations in Namibia and laid off around 2,000 workers on April 16, 1998 [Business Day Online (Johannesburg), April 20, 1998, Gold Fields Namibia aims to liquidate three mines, accessed April 21, 1998, at URL http://www.bday.co.za/98/0420/company/e6. htm].

In other copper developments in 1997, Namibia Copper Joint Venture (Pty) Ltd., a partnership between the Australian firm of Great Fitzroy Mines NL (20%) and Namibia Copper Mines Inc. (80%) of the United States, completed a bankable feasibility study of the Haib porphyry copper deposit. Production could start by mid-2000. The Haib deposit has a reported minable resource of

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604 million metric tons (Mt) of 0.341% copper. Project costs to develop the Haib open pit mine and associated solvent extraction/electrowinning facilities are estimated to be $560 million. The mine will operate at a rate of 94,000 tons per day of ore which is suitable for leaching and flotation and roasting. Production capacity is expected to be more than 100,000 t/yr of copper, 530 kilograms per year of gold, and 880 t/yr of molybdenum concentrate. The feasibility study, conducted by Minproc Engineers Ltd. and Kvaerner Davy, was based on a copper price of $0.95 per pound and may have to be adjusted for declining copper prices (Namibia Copper Joint Venture (Pty) Ltd., 1998).

Imcor Tin (Pty.) Ltd., which operated the Rosh Pinah zinc-lead-silver mine, produced 40,519 t of zinc contained in 74,632 t of concentrates, up 13% from 1996. The 26,288 t of lead concentrates produced contained 12,769 t of lead and 4.97 t of silver; these totals were up 3% and down 60%, respectively, from those of 1996. Most of the zinc concentrates are exported to Zincor in South Africa, and the lead concentrate is toll refined at Tsumeb where the silver is also recovered. Exploration in 1997 has proven sufficient additional ore reserves to extend the life of the mine from 3 years to 12 years. An extended period of uncertainty ended in 1997 with the signing of a memorandum of understanding on share holding and royalties between Imcor's principal owners, Iscor Ltd. of South Africa and Namibian Mining Ventures (Chamber of Mines of Namibia, 1998b; Namibia Economist, July 12, 1997, Zinc at Rosh Pinah to last another 12 years, accessed December 8, 1997, at URL http://www.economist.com.na/july12/july12-story9.html). Namibian Mining Ventures is a subsidiary of PE Minerals, a consortium of Namibian and Malaysian businessmen, who hold the mineral rights to Rosh Pinah. A new operating company, based out of Windhoek, is to be set up under the terms of the agreement (Mining Mirror, 1998).

In a potentially major zinc sectoral development, Reunion Mining plc. of the United Kingdom completed exploration drilling and a prefeasibility study on the Scorpion zinc deposit, 20 kilometers (km) north of the Rosh Pinah Mine, during 1997. By yearend, Reunion had earned a 24% interest in the Scorpion deposit from the Anglo American subsidiary, Erongo Mining and Exploration Co. Ltd. By the end of 1998, Reunion expects to earn a full 60% interest in the project by completing the feasibility study and making a commitment to develop the mine. Drilling results have outlined a mineral resource, based on a zinc price of $0.55 per pound, of 21 Mt, grading 8.4% zinc, of which the probable reserve is 15 Mt, grading 11.3% zinc. Reunion geologists described the zinc mineralization as unusual in that it occurs predominantly in a zinc-rich clay, sauconite, along with zinc oxides and hydroxides. The sauconite is found in a highly altered and weathered zone of intense faulting and brecciation at a contact of limestone and clastic sediments. The deposit is minable by open pit methods at a 2.5-to-1 ore-to-waste ratio and amenable to treatment by sulfuric acid leaching, solvent extraction, and electrowinning. An output of 130,000 to 150,000 t/yr of Special High Grade zinc metal during a project life of 10 to 12 years is planned. Preliminary estimates place capital development costs at more than $160 million (Reunion Mining plc, 1998, p. 8-9).

Gold.—In 1997, gold production decreased by some 13% compared with that of 1996. Erongo's Navachab gold mine produced 2,302 kg, accounting for 95% of the national total during 1997. The ore treatment plant at Navachab was upgraded during 1997 to increase throughput to 1.3 million metric tons per year (Mt/yr). A reevaluation of ore reserves and pit modeling was expected to extend the life of the Navachab Mine.

Manganese.—Production of manganese from Otjosondu Mine, 160 km northeast of Windhoek, was 57% less than that of 1996. Privately owned Purity Manganese was forced to cut back on production during 1997 in response to weak demand for manganese by the global steel industry. The company also began plans to move from an open pit to an underground operation during the year. The underground ore has a manganese content of more than 46% and a manganese-to-iron ratio of 9 to 1.

Tin.—A cooperative project between the Ministry of Mines and Energy and the Swedish International Development Co-operation Agency has been using the old Uis tin pegmatites to test a pilot small-scale mining program. The project aimed at legalizing the small-scale tin mining operations, evaluating mining methods, and setting up a drilling and blasting team. A small concentration plant was built, and assistance was provided in locating markets for the tin production. More than 3 t of tin concentrate was produced in 1996, and the first product shipments were made in 1997. During 1997, additional efforts were made to increase technical productivity and business skills of the small-scale miners. It is planned to extend the same project model to South Africa (Ericsson, 1997).

Uranium.—Despite continued weak uranium markets, Rossing increased production of uranium oxide by more than 7% to 3,425 t in 1997 to meet standing customer commitments. This still left the mine operating at only about two-thirds of capacity. The fourth largest producing uranium mine in the world, Rossing was owned 68.6% by RTZ Corp. plc.of the United Kingdom. Rossing plays an important part in the Namibian economy, accounting for about 12% of the GDP, 12% of exports, and 4% of total tax revenue.

Industrial Minerals

Diamond.—The coastal and offshore diamond resources of Namibia represent a major global source of diamond. It has been estimated that roughly 10 billion carats of diamonds were eroded from diamondiferous kimberlite pipes in the interior of southern Africa during the Tertiary period. Of this amount, an estimated 3 billion carats are estimated to have survived the glacial and fluvial trip to the Atlantic Coast beaches of Namibia, near the mouth of the Orange River, during millions of years. The subsequent northward movements of the offshore Benguela Current have distributed diamond deposits along a substantial portion of the Namibian coastline. The diamonds found here are relatively consistent in size and quality and average around $200 per carat [Cape Business News (Capetown), January 1998, The great diamond rush: accessed April 7, 1998, at URL http://www.cbn.co.za/issue/jan98/diamonds.htm]. In 1997, production of diamond in Namibia increased by 1% to 1.42 million carats. Namdeb accounted for 1.36 million carats of this output; about 65% came from onshore mining on its concession which covers nearly 130 km of the coastal strip northwards of the Orange River. In 1996, Namdeb moved 53.8 Mt of waste and ore

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material and treated 20.9 Mt of beach sand materials, recovering 768,757 carats at a grade of 3.7 carats per 100 tons. In April 1997, De Beers commissioned a new bucket wheel dredge and a floating treatment plant at a cost of $40 million. This added capacity will allow more than 70 Mt of material to be mined a year and Namdeb to maintain diamond production at current levels for another 10 years. Many of the high-grade coastal deposits have been mined out, and production has been shifting to deeper offshore waters (Gooding, 1997).

De Beers Marine (Debmarine), a subsidiary of the South African-based De Beers Consolidated Mines, handled offshore marine mining for Namdeb, accounting for about 480,000 carats equal to 35% of Namdeb diamond production in 1997. Their concession extends from Oranjemund to Luderitz and up to 200 km into the Atlantic Ocean. Debmarine developed a new generation of undersea mining equipment that uses either flexible slurry hoses or a large 6- to 7-meter (m) diameter circular drillhead. The new technology allows them to mine in water up to 200 m in depth and lower grade deposits economically. Debmarine's floating treatment plant with a 3,500-metric-ton-per-hour (t/hr) capacity was commissioned in 1997. A fifth mining vessel is to be commissioned by yearend 1998. De Beers' $12 million diamond cutting and polishing plant at Okahandja was on schedule to begin operations in early 1998.

Namco, a United Kingdom-based firm listed on the Toronto and Namibian stock exchanges, was scheduled to began commercial mining of diamonds in early February 1998, following favorable bulk sampling results on its Hottentots Bay and Luderitz Bay marine concessions. In December 1997, Namco took delivery of a NamSSol, a 120-t underwater mining crawler, which will be operated from the mining vessel *MV Kovambo*. The NamSSol crawler, operating 20 hours per day during an expected life of 10 years, will deliver a slurry containing 18% solids to the processing plant on the *Kovambo*. The processing plant will treat 50 t/hr with an expected recovery of 90% of the diamonds. Namco expected to treat 1 million cubic meters of seabed gravels and to recover at least 150,000 carats per year of diamond from the first mining area, with an average size of around 0.36 carat and an average value of $190 per carat. Full capacity operations were expected by mid-1998. Project capital costs were $18 million (Mining Magazine, 1997).

In its second year of operation, ODM produced 57,021 carats in calendar year 1997 from two offshore vessels, the *MV Namibian Gem* and the *Oceandia,* and evaluated concessions covering an area of 3 nautical miles around the 12 islands off the Namibian coast from Luderitz. Production was up 9% from that of 1996 (Ocean Diamond Mining Holdings Limited, 1997, Carats, historical diamond production, accessed May 22, 1998, at URL http://www.odm.co.za/odm8.htm). The *Namibia Gem* is the principal mining vessel, and the *Oceandia* is used mainly for ore-reserve-development sampling. The *Namibia Gem*, a former oil rig supply ship, operates two 16-inch airlift dredging heads and has the capacity to treat 50 t/hr of sediment in an onboard dense medium separation (DMS) plant. The first deposit mined in the Basin Deposit in the Halifax Island area yielded excellent quality stones with an average size of 0.45 carat per stone, valued at $189 per carat in 1997. Ore reserves in this area were estimated to be 220,000 carats [Cape Business News (Capetown), January 1998, ODM is the young tiger, accessed April 7, 1998, at URL http://www.cbn.co.za/issue/jan98/ocean.htm]. ODM's first controlled underwater dredger, ADA ("articulated dredging arm"), will be commissioned in March 1998.

In December 1997, Nora Exploration Inc. of Canada signed an option agreement with Namibian Gemstones Mining Corp. (Pty) Ltd. whereby Nora can obtain a 70% interest in the exploration and mining of the second largest offshore diamond area in Namibia by expending $1.2 million and paying Namibian Gemstones $3.6 million by September 15, 1998. Nora's initial work will include a detailed geophysical survey. Namibia Gemstones, a private Namibian company, holds a 23,000-km^2 deep-water concession extending northward from the Namibia/South Africa border from the 200-m isobath and deeper (Nora Exploration Inc., 1997). Noragem (Pty) Ltd., a wholly owned subsidiary of Nora, holds all the corporation's assets in Namibia, including a 47% equity interest in Otjua Minerals (Pty) Ltd., which controls exploration and mining permits in Namibia.

In March 1997, Diamond Fields International Ltd. of Canada and its subsidiary, Namibian West Coast Diamond Company (Pty) Ltd. (NWCDC), acquired all the subsisting rights of BHP Minerals International Exploration Inc. (BHP) of Australia and Benguela Concessions Limited (Benco) not already owned by NWCDC in the Luderitz offshore diamond mining concessions. BHP and Benco ceded their rights to earn a 50% interest in Diamond Fields under the terms of a 1994 agreement in exchange for shares representing an 11.6% equity interest in Diamond Fields (Diamond Fields International Ltd., March 5, 1997, Diamond Fields concludes agreement with BHP and Benguela on Luderitz offshore diamond concession, press release, accessed April 20, 1997, at URL http://www.newswire.ca/releases/March1997/05/c0897.html). During exploration of the 660-km^2 Luderitz offshore grants in 1994 and 1995, Diamond Fields delineated an indicated and inferred resource of more than 1.1 million carats; work on the project, however, was suspended after Diamond Fields' discovery of the Voisey's Bay nickel deposit in Labrador, Canada. The company resumed work on the property in late 1997 and will proceed with a $15 million program, including advanced diamond sampling, a capital upgrade of the diamond- processing plant at Luderitz, and a project feasibility study for a 500,000-carat-per-year mine plan in 1998. A decision whether to proceed with mining will be made in late 1998 (Diamond Fields International Ltd., December 22, 1997, Diamond Fields International to proceed with diamond sampling and mine feasibility study on seabed grants on the coast of Namibia, press release, accessed January 7, 1998, at URL http://www.newswire.ca/releases/December/1997/22/c5176.html).

In 1997, Trans Hex International Ltd., the Canadian diamond exploration subsidiary of the South African parent company, Trans Hex Group Ltd., expended $3.8 million on Block 9 of its Northbank, Orange River property. The money was spent on drilling and constructing a 100-t/hr HMS plant. Lazare Kaplan International of the United States had a 50% interest in the Northbank project. Drilling had indicated diamondiferous basal gravel resources of 30 million cubic meters (Mm^3) in an oxbow paleochannel 1 km wide by 4.5 km long (Trans Hex International Ltd., August 26, 1997, Trans Hex International Ltd. progress report on alluvial diamond exploration projects, press release, accessed August 26, 1997, at URL http://biz.yahoo/bw/97/08/26/thi_y0023_1.html).

Four companies—DebMarine, Diamond Fields International, Namco, and ODM—established the Namibian Marine Diamond Mining Association to act as one body in discussions with the Government on diamond prospecting and mining operations and

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regulations.

Fluorspar.—In 1997, Okorusu Fluorspar (Pty.) Ltd. was purchased by the Solvay Group of Belgium. The company experienced a further decline in fluorspar production to 23,208 t, a 28% decrease from that of 1996, and less than half of its 50,000-t capacity. Solvay planned to export all of the acid-grade fluorspar production to its hydrofluoric acid plant at Bad Wimpfen, Germany. Okorusu will account for a significant portion of Solvay's 70,000-t/yr demand for acid-grade fluorspar in Europe (Industrial Minerals, 1997a). The problem of excess silica in the new ore body was addressed with the commissioning of a new heavy medium separation plant in February 1997. In 1996, the Ministry of Mines and Energy approved the European Community's soft loan of $1.4 million to Okorusu for the removal of 1.2 Mt of overburden so that the "A" pit at Okorusu can be reactivated. Solvay planned to upgrade the productivity and technical aspects of the operation and to increase capacity to 80,000 t/yr by 1999 (Industrial Minerals, 1997a).

Salts.—In 1997, production of sodium chloride salt, industrial and refined, increased by 38% to 492,780 t. Salt and Chemicals (Pty.) Ltd. was the primary producer accounting for 432,290 t. In a development that will make Namibia one of the world's largest salt producers, the local company, Namsalt Holdings, owned by LKC Investment Holdings, announced plans to expand its salt production and refining capacity and to build a packaging plant and a bulk loading facility at its Cape Cross salt pan operation, 150 km north of Walvis Bay. The loading terminal will be on a floating barge from 500 to 600 m out at sea. Cape Cross will have the capacity to handle from 800,000 t to 1 Mt by the end of 1999. Investment costs were estimated to be between $12 million and $20 million. Namsalt also planned to increase their handling of bagged salt through Walvis Bay harbor from 120,000 t to between 180,000 and 200,000 t. Salt exports will be primarily to other African markets [Christof Maletsky, January 27, 1998, Namsalt aims to head world's salt market, Business Day Online (Johannesburg), accessed January 27, 1998, at URL http://www.bday.co.za/98/0127/world/w14.htm].

International Project Development, a subsidiary of the Berlin Engineering Group of Germany, planned to invest around $80 million to extract minerals from seawater near Walvis Bay. Subject to completion of project financing, full production from two seawater-treatment plants would begin by April 1999. An advanced electrodialysis process would extract aluminum, magnesium, bromine, and sodium salts, sulfur, and carbon dioxide among its byproducts. The process would also produce a "waste product" of 4 Mm^3 of potable water. The latter's production in an export processing zone, where 70% of production must be exported, placed the domestic use of the desalinated drinking water in question [Christof Maletsky, January 8, 1998, R480m plan to extract products from sea, Business Day Online (Johannesburg), accessed January 8, 1998, at URL http://www.bday.co.za/98/0108/news/n22.htm].

Mineral Fuels

Exploration for petroleum and natural gas remained active during 1997. Participating companies included Norsk Hydro, Saga, and Statoil of Norway; Sasol and Energy Africa of South Africa; Ranger Oil of Canada; Hardy Oil & Gas of the United Kingdom; Amerada Hess, Chevron, and Texaco of the United States; and Shell Exploration and Production BV of the Netherlands. Exploration through 1997 has identified four main offshore gas basins—Namibe Basin, in the north, extending to Walvis Ridge; Walvis Basin; Luderitz Basin, covering an area from Walvis Basin to Luderitz; and Orange Basin, extending to the south to South Africa's border.

The most promising field is the Kudu Block in the Orange Basin, which was originally discovered by Chevron in 1973. The Kudu Block is now held by Shell (75%), Texaco (15%), and Energy Africa (10%). Estimates by NamPower indicated that this field contained reserves of 280 billion cubic meters (Gm^3) of low-sulfur natural gas and could achieve gas flow rates in excess of 2.1 million cubic meters per day. Intensive seismic studies indicate the potential for up to 283 Gm^3, sufficient to power a 2,000-megawatt (MW) powerplant for more than a century (U.S. Embassy, Pretoria, South Africa, 1996). Other reports indicate that Shell and the Kudu Field's other operators feel that these reserve estimates may be too optimistic and that Kudu recoverable gas reserves are more in the order of 56 Gm^3. In May 1997, NamPower reached an agreement with the South African power company, Eskom, to build a 750-MW combined cycle powerplant at Oranjemund that will use Kudu natural gas reserves. A development decision is expected by mid-1998, which could result in the first gas production and electricity generation in late 2000 or early 2001. The Shell partnership will finance the $350 million development of the Kudu gas field while sharing the $500 million cost of building the powerplant with NamPower and Eskom [Mbendi Information Services (Pty.) Ltd., March 25, 1998, Namibia—Oil industry profile—Upstream, accessed September 22, 1998, at URL http://mbendi.co.za/indy/ oilg/oilgnaus.stm]. A new gas powerplant would help alleviate the current power shortage in the country, which has been acerbated by a shortage of rain to local hydroelectric dams.

Reserves

Other than individual company reserve data reported in the above commodity discussions, an accounting of mineral reserves of the major producing mines in Namibia was not available for this review. An on-line discussion of potential mineral investment opportunities in Namibia is presented in project profiles by the Ministry of Mines and Energy [Ministry of Mines and Energy, November 26, 1997, Mining investment opportunities in Namibia, Africa Trade and Business Bulletin, accessed September 10, 1998, at URL http://www. bizafrica.com/namibia/busbul/minopp/ minopp.html#proj (see mining project links at end of text). Note: Internet site cited superseded by commercial site http://www.bizeurope.com/bsr/country/Africa.htm].

Infrastructure

Namibia has two principal ports, Walvis Bay and Luderitz. Walvis Bay has container and bulk mineral-handling facilities and oil storage tanks. More than 1 Mt/yr of freight is handled at Walvis Bay compared with 50,000 t/yr at Luderitz. Since the March 1994 return of Walvis Bay from South Africa, the Government has established the port as a free-trade zone, or export processing zone (EPZ), and expects it to become an important commercial gateway for the southern African region. Namibia has a well-developed and well-maintained road transport system, with

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THE MINERAL INDUSTRY OF

MOZAMBIQUE

By George J. Coakley

The Republic of Mozambique is located on the southeast coast of Africa and has an area of 749,090 square kilometers (km^2). In 1997, the area supported a population of 18.2 million and a gross domestic product (GDP) per capita, based on purchasing power parity estimates in 1995, of $670. Following nearly 30 years of fighting prior to gaining independence from Portugal in 1974 and then resolving a prolonged internal civil war, 1994 finally brought peace and a freely elected Government to Mozambique. In 1997, the economy began to show the turnaround hoped for under the rigorous International Monetary Fund and World Bank structural adjustment program began in the late 1980's—the GDP grew by 14%, inflation was a single digit, and export trade increased. The country's high foreign debt load, however, remained a problem. The minerals and energy sectors played secondary roles to agriculture and fishing in the economy but were the targets for several major new foreign investment proposals. Efforts to rebuild the economy have placed major emphases on mineral-resource development and regional economic integration. Nearly $12 billion in new mineral and infrastructure development projects were being considered by Government and private foreign investors in 1997. Priority also continued to be given to the removal of land mines around the major transportation routes and population centers. Development plans to date depend heavily on the energy potential of the underutilized Cabora Bassa hydroelectric dam; the Pande, the Temane, and the Buzi natural gas fields; and the coal resources at Moatize; and on modernization of the Indian Ocean export harbors at Beira, Maputo-Matola, and Nacala and associated transportation infrastructure. In the metals sector, studies were underway to determine the feasibility of developing major aluminum, iron, and titanium projects. Resources of dimension stone, gemstones, gold, niobium, petroleum, phosphates, rare-earth minerals, and tantalum were also known (Mozambique Ministry of Mineral Resources and Energy, 1995). Mozambique continued to be an important source of labor for the South African gold industry, with about 60,000 Mozambican miners employed in Witswatersrand gold mines. Repatriated wages from this workforce provided a significant contribution to the Mozambican economy.

The national mining and petroleum policy is directed at promoting foreign investment and exports, thus increasing the supply of raw materials for domestic industries and minimizing direct government participation in mineral activities. The minerals industry is regulated by the Mining law No. 2/86 of April 16, 1986, as amended by law 5/94 of September 18, 1994, and by the Mining Law Regulations (Decree 13/87 of February 24, 1987). The Mining law is administered by the Minister of Mineral Resources and Energy through the National Directorate for Mines. Tax and other fiscal matters for the mining sector are regulated by the Mining Tax Code (Decree 53/94 of November 9, 1994). Petroleum rights and licensing are regulated by the Petroleum law (Decree No. 3/81) of 1981. Under this law, the national oil company, Empresa Nacional de Hidrocarbonetos (ENH), has statutory responsibility for the exploration and development of natural gas and petroleum resources and can enter into joint ventures and other forms of contractual relations with private companies. Petroleum licensing usually takes the form of a production-sharing agreement with ENH, and natural gas exploration and development takes the form of profit-sharing joint ventures.

The mining industry was chiefly noted for its production and export of bauxite, bentonite, gemstones, graphite, and marble. In addition to these minerals, small quantities of gold along with some industrial mineral commodities, including cement, marine salt, and sand and gravel, were produced. Mineral commodity production, as reported by the Ministry of Mineral Resources, and Energy, is shown in table 1. Official exports were dominated by bauxite, gemstones, graphite, and marble.

Billiton Plc's South African subsidiary, Alusaf, Ltd., in partnership with Industrial Development Corp. (IDC) of South Africa, has formed the Mozambique Aluminum Co. (Mozal). Billiton is the United Kingdom-based, offshore arm of Gencor Ltd. of South Africa. Following completion of a $5 million feasibility study, Billiton announced plans to develop a 245,000-metric-ton-per-year (t/yr) aluminum smelter 17 kilometers (km) west of Maputo. Construction is expected to begin near mid-1998 and to be completed by yearend 2000. Feedstock for the smelter will be source from Billiton-owned alumina plants in Australia, Brazil, and Suriname. The company was targeting a 50-50 debt-to-equity ratio to finance the $1.2 billion project. Additional American, Brazilian, or Japanese investors were being sought. Provision has been made at the site to double capacity size to 490,000 metric tons (t) in the future. An engineering, procurement, and construction management contract has been awarded to the joint venture company comprising SNC Lavalin of Canada and Murray and Roberts Engineering Management Services of South Africa. This is the same group that recently built the 466,000-t/yr Alusaf aluminum smelter in Richards Bay, South Africa. The Government approved an environmental impact assessment of the project conducted by the Council for Scientific and Industrial Research of South Africa, the Mozambique Ministry of Environmental Affairs, and the World Bank. The competitive position of the Mozal smelter has been aided by an electricity tariff agreement between the South African power company, Eskom, and the Mozambique electricity supply authority and by the granting of a tax-free industrial zone status to the project by the Mozambican Government. The tariff agreement will allow power

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a railway network that links the principal centers of population to the coast and to South Africa. The country has about 40,000 km of roads, of which about 4,500 km is surfaced. A principal north-south axial road links southern Angola with South Africa, and east-west routes connect the Namibian coastal ports of Luderitz, Swakopmund, and Walvis Bay with South Africa and Botswana. The 2,400-km-long rail network is operated by TransNamib. The rail fleet consists of 100 diesel-electric locomotives and 2,400 railcars. Namibia's railways carry about 2 Mt/yr of freight.

Electricity throughout the country is provided by NamPower. Principal power stations include the 120-MW Van Eck coal-burning plant in Windhoek and the 240-MW Ruacana hydroelectric station on the Kunene River. The NamPower network interconnects with South Africa's power grid.

Outlook

The final depletion and closure of the world famous Tsumeb copper-lead-zinc mine in 1996 and the subsequent early 1998 decision by Gold Fields to liquidate the Tsumeb Corp. Ltd. operations in Namibia have put a damper on the long tradition of mining in Namibia. A reopening of the traditional diamond regions in the south to exploration for other commodities and the renewed interest in offshore and mainland mineral exploration opportunities by foreign investors, however, has given hope for a new generation of mineral and energy projects in Namibia. Proposed new diamond, copper, and zinc mines and the potential for new value-added manufacturing or metal-processing industries supported by the development of the Kudu natural gas field should keep the mineral sector a central part of the economy of Namibia for the foreseeable future. In the longer run, greater development of regional transportation infrastructure in northern Namibia, including the Caprivi Strip, could see Walvis Bay become a significant export route for new mineral developments in Angola and in the landlocked countries of Botswana and Zambia. With a climate that is among the driest in the world, Namibia will continue to deal with the lack of water resources as a constraint on development.

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The Chamber of Mines of Namibia
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Fax: (264) 61 249-146
Internet: http://www.gsn.gov.na/survey.htm

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Ministry of Trade and Industry
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Telephone: (264) 61 229-933
Fax: (264) 61 220-227
Government Internet site: http://www.republicofnamibia.com

Namibia National Small Miners Association
P.O. Box 7289
Windhoek, Namibia
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Fax: (264) 61 31188

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TABLE 1
NAMIBIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 3/
METALS						
Antimony, sodium antimonate (47% Sb):						
Gross weight		13	29	--	16	--
Sb content		6	14	--	8 e/	--
Arsenic, white, 99% arsenic trioxide		2,290	2,775	1,661	1,559 r/	1,232
Beryl concentrate		15	--	--	--	--
Cadmium metal, refined		13	19	15 e/	14	2
Cesium, pollucite, gross-weight e/		5	5	--	--	--
Copper:						
Mine output, concentrate (29% to 30% Cu):						
Gross weight		110,000	97,900	81,646	57,095	72,055
Cu content		29,500	28,400	22,530	14,845	20,320
Metal, blister 4/		34,800	30,100	29,799	16,659 r/	22,042
Gold	kilograms	1,953	2,445	2,394	2,145 r/	2,433
Lead:						
Mine output, concentrate (30% to 32% Pb):						
Gross weight		36,400	43,800	57,105	58,197	32,378
Pb content		11,600	13,917	16,084	15,349 r/	13,577
Metal, refined, primary 4/		31,200	23,800	26,752	8,588 r/	1,242
Manganese: Mine output, concentrate (44% Mn):						
Gross weight		--	--	95,385	92,647 r/	39,671
Mn content		--	--	43,004	40,765 r/	17,455
Silver, mine output, Ag content of concentrate	kilograms	72,000	62,000	69,000	42,352	33,540
Tin: Mine output, concentrate (61% to 67% Sn):						
Gross weight		6	6 e/	--	--	--
Sn content		4	4 e/	2	--	--
Uranium, U_3O_8 content of concentrate		1,980	2,235	2,366	3,188	3,425
Zinc: Mine output, concentrate (49% to 53% Zn):						
Gross weight		34,557	64,568	59,290	69,689 r/	74,632
Zn content		17,624	33,400	30,209	35,873 r/	40,519
INDUSTRIAL MINERALS						
Diamond:						
Gem e/	thousand carats	1,120	1,312 3/	1,382 3/	1,402 r/	1,416
Industrial e/	do.	20	--	--	--	
Total 5/	do.	1,141	1,312	1,382	1,402 r/	1,416
Fluorspar, concentrate, acid grade (97% CaF_2)		43,466	52,226	36,889	32,285	23,208
Gypsum e/		380	121	--	--	--
Lithium minerals:						
Amblygonite		5	5 e/	3	46 r/	75
Lepidolite		87	90 e/	106	355	275
Petalite		647	650 e/	2,502	1,571	669
Total		739	745 e/	2,611	1,972 r/	1,019
Salt 6/		132,585	356,965	303,986	355,868 r/	492,780
Semiprecious stones:						
Agate		102	175	115	150	175
Amethyst		100	338	5	19	23
Chrysocolla	kilograms	6,500 e/	6,500	--	--	--
Dioptase	do.	50 e/	50 e/	--	--	--
Quartz, crystal e/		50	50	--	15	--
Rose quartz		166	170	200	190	220
Sodalite		354	1,143	465	383	1,598
Tourmaline	kilograms	600 e/	600 e/	--	437 r/	53
Stone, sand and gravel:			--			
Dolomite		--	--	--	5,401	7,635
Granite		2,952	11,585	4,518	5,218	6,675
Marble		13,359	12,061	16,935	12,673 r/	13,743
Quartz e/		339	350	--	--	--

See footnotes at end of table.

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TABLE 1--Continued
NAMIBIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1993	1994	1995	1996	1997
INDUSTRIAL MINERALS--Continued					
Sulfur, pyrite concentrate:					
Gross weight (49% to 51% S)	113,703	121,634	103,140	90,735	94,585
S content	56,900	60,000 e/	51,330	45,338	46,476
Wollastonite	824	1,309	967	248 r/	194

e/ Estimated. r/ Revised.
1/ Estimated data are rounded to three significant digits.
2/ Table includes data available through Sept. 30, 1998.
3/ Reported figure.
4/ Includes products of imported concentrate.
5/ Data may not add to totals shown because of independent rounding.
6/ The increase in 1994 is due to production from Walvis Bay previously included under South Africa.

Sources: Ministry of Mines and Energy, July 2, 1998, minerals questionnaire and Chamber of Mines 1997 annual report.

TABLE 2
NAMIBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper		Tsumeb Corp. Ltd. (Gold Fields Namibia Ltd., 66%)	Khusib Springs Mine	15,500 copper in concentrate.
Do.		do.	Tsumeb smelter	60,000 blister copper.
Do.		do.	Kombat Mine, 50 kilometers south of Tsumeb	10,000 copper in concentrate.
Do.		Otjihase Mine (Tsumeb Corp. Ltd., 70% JCI Ltd., 30%)	Otjihase Mine, near Tsumeb	18,000 copper in concentrate.
Diamond	thousand carats	Namdeb Diamond Corp. (Pty.) Ltd. (De Beers Centenary AG, 50%; Government, 50%)	Mines near Oranjemund; Elizabeth Bay Mine, 25 kilometers south of Luderitz; and marine operations.	1,600.
Do.	do.	Namibian Minerals Corp.	Marine operations offshore Luderitz and Hottentots Bay	750.
Do.	do.	Ocean Diamond Mining	Marine operations offshore Luderitz	60.
Fluorspar		Okorusu Fluorspar (Pty.) Ltd. (Solvay Group, 100%)	Okorusu, 48 kilometers north of Otjiwarongo	50,000, 98% calcium fluoride.
Gold		Erongo Mining and Exploration Co. Ltd. (Anglo American Corp. 57.5%, Inmet Mining Corp. 20%; Randgold Ltd., 10%)	Navachab Mine near Karibib	3.
Lead		Tsumeb Corp. Ltd. (Gold Fields Namibia Ltd., 66%)	Tsumeb (Ausmelt) smelter	24,000 lead bullion
Do.		Imcor Tin (Pty.) Ltd. (Iscor Ltd., 100% , Namibian Mining Ventures, 50%)	Rosh Pinah Mine, 80 kilometers northeast of Oranjemund	15,000 lead in concentrate.
Lithium		SWA Lithium Mines (Pty.) Ltd. (Kloeckner; Matramco)	30 kilometers south of Karibib	1,500 concentrate.
Manganese		Purity Manganese (Namibia) Ltd. (private, 100%)	Otjosondu, 160 kilometers northeast of Windhoek	100,000 ore with 45% manganese content.
Salt		Salt and Chemicals (Pty.) Ltd. (Sentrachem, 100%)	Walvis Bay	350,000.
Do.		Salt Company (Pty.) Ltd. (private, 100%)	Swakopmund	150,000.
Stone	cubic meters	Karibib Mining and Construction Co. (Namibia) Ltd. (private, 100%)	Granite quarry at Karibib	600.
Do.		do.	Marble quarry at Karibib	2,500.
Uranium		Rossing Uranium Ltd. (RTZ Corp. plc., 68.6%; Industrial Development Corp. of South Africa; Government of Iran; Rio Algom, Canada)	Rossing, 30 kilometers east of Swakopmund	5,000 uranium oxide.
Zinc		Imcor Tin (Pty.) Ltd.	Rosh Pinah Mine, 80 kilometers northeast of Oranjemund	40,000 zinc in concentrate.

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THE MINERAL INDUSTRY OF

NIGER

By Philip M. Mobbs

Niger was an internationally important uranium producer, annually exporting concentrate containing approximately 3,000 tons of yellow cake (U_3O_8). Other commercially exploited minerals were coal, gypsum, limestone, molybdenum, salt, and tin. The country had a significant area of the Birimian greenstone belt under exploration for gold. According to the Ministère des Mines, de l'Industrie et de la Technologie (1997), Niger also had indications of barite, columbium-tantalum, copper, chromite, graphite, iron ore, lead, lithium, monazite, molybdenum, nickel, phosphates, platinum-group metals, silver, talc, titanium, and zinc resources. Mining accounted for about 4% of the gross domestic product.

Law 93-016 of March 2, 1993, and Decree No. 93-044/PM/MMEI/A of March 12, 1993, provided the legal framework for the mining industry. The mining law provided a number of promotional incentives and guarantees, including duty-free import of capital equipment, guarantees against expropriation, and the right to repatriate earnings and dividends. Additional laws affecting the mineral industry included the General Fiscal System, the General Customs and Excise System, the Exchange Regulation, the Labor and the Trade Acts. The Government retained 10% free equity in mining ventures and the option to purchase an additional 23% equity in mineral-production ventures. There was a 5.5% royalty on the commercial value of exported minerals. Mineral industry operations in southwestern Niger did not appear to be adversely affected by the national unrest attributed to drought, famine, and political turmoil (Mining Journal, 1998a).

The three major greenstone gold belts in the Liptako region of western Niger were the focus of the gold rush. The Gorouol (or Kourki) Belt bordered Burkina Faso and Mali in the northwest of the Liptako area, the Sirba Belt was west of Niamey, and the Tera Gassa Belt was between the Gorouol and the Sirba greenstone belts (Bureau of Geological Consultancy, 1993). A number of small-scale miners were producing from operations in the Sirba Belt. The Government estimated that production of artisanal gold from the entire Liptako region was about 1 metric ton per year; artisanal miners numbered in the tens of thousands.

Ashanti Exploration Ltd., a subsidiary of Ashanti Goldfields Co. Ltd. of Ghana, was the operating partner for three joint ventures. Ashanti continued mapping and trenching of the Namanga zone on the Tera gold property for its joint venture with Carlin Resources Corp. of Canada. In the Sirba greenstone belt, Ashanti sampled and began drilling the Tampena anomaly on the Nassile concession of Royalstar Resources Ltd. of Canada. North of the Nassile concession, Ashanti continued to explore the Libiri prospect on the Saoura concession for the joint venture with International African Mining Gold Corp. (IAMGOLD) of Canada.

Auspex Minerals Ltd. of Canada delineated a number of gold prospects on the Koulbaga gold concession, southeast of the Tera concession, by using geochemical sampling of termite mounds and soil, trenching, geophysical surveys, and drilling.

Etruscan Enterprises Ltd. of Canada acquired Hansa GeoMin Consult GmbH of Germany's remaining interest in the African GeoMin Mining Development Corp. (AGMD). AGMD owned the Tiawa concession, northwest of the Saoura concession, where Etruscan was evaluating the Bolon Djounga anomaly. Also on the Tiawa concession, Placer Dome of Canada was exploring the 81-square kilometer (km^2) Samira deposit under an option agreement with Etruscan. Etruscan and the Office National des Resources Minières were exploring the Koma Bangou prospect east of the Tera concession. Additionally, Etruscan obtained an option to earn 50% interest in the Kossa permit in the Gorouol Belt, 225 kilometers (km) northwest of Niamey, from Berlant General Trading Establishment of Kuwait.

EXP Resources Ltd. of Canada was earning 60% interest in the Tin-Awati gold-copper concession from Proma Minerals SA of Norway. EXP's activity on the permit south of Etruscan's Kossa concession included trenching and sampling old artisanal workings and a program of aerial magnetic and radiometric surveys. First Quantum Minerals Ltd. of Canada completed geochemical analysis of soil and stream sediment and earned 45% interest in the Sakoira gold exploration permit held by Reunion Mining plc. of the United Kingdom. Because of discouraging exploration results, Reunion subsequently terminated the project. Sumitomo Corp., a subsidiary of Sumitomo Metal Industries, Ltd. of Japan, and Imperial Metals Corp. of Canada continued the geophysical evaluation of the M'Banga concession.

Also exploring in Niger were Al-Qudairi International Trading and Contracting of Kuwait on the Tringui concession in the Tera Gassa Belt, Barrick Gold Corp. of Canada on the Tialkam concession in the Sirba Belt, and Pioneer Goldfields Ltd. of the United Kingdom, a subsidiary of Pioneer Group, Inc. of the United States, on the Deba concession in the Sirba Belt.

Small quantities of tin ore were mined at Agahak, El Mécki, Guissat, Tarouadji, and Timia in the Aïr Mountains of central Niger, northeast of Agadez.

Uranium concentrates were produced by the Société des Mines de l'Aïr (SOMAÏR) and Compagnie Minière d'Akouta (COMINAK) of Niger. Uranium remained the main mineral commodity mined in Niger and accounted for about 70% of Niger's foreign exchange earnings (Mining Journal, 1998b). SOMAÏR's open-pit operations were northwest of Arlit, approximately 250 km northwest of Agadez. COMINAK's underground operations were near Akouta, approximately 10 km southwest of the SOMAÏR pits.

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Production of industrial minerals and mineral fuels was limited to a few commodities that were consumed domestically. The Government proposed to sell 77% of its equity interest in the Malbaza Cement Works of Societé Nigérienne de Cimenterie.

Esso Exploration and Production Niger Inc., a subsidiary of Exxon Corp. of the United States, and its partner, Elf Aquitaine S.A. of France, continued seismic studies and resumed exploration drilling on the Agadem concession in southeastern Niger. TG World Energy Inc. of Canada was issued an oil prospecting license in the Ténéré region adjacent to the Esso-Elf permit.

The mineral industry of landlocked Niger depended on road and rail transportation to access the ocean. The ports of Abidjan, Côte d'Ivoire, and Cotonou, Benin, were connected by railroad to terminals at Ouagadougou, Burkina Faso (approximately 500 km by highway from Niamey, the capital of Niger), and Parakou, Benin (approximately 560 km by highway from Niamey), respectively. Highways also linked Niamey with ports at Accra, Ghana; Abidjan; Cotonou; Lagos, Nigeria; and Lomé, Togo.

Uranium will probably remain the most important mineral commodity produced in Niger and the largest foreign exchange earner for the immediate future; the proposed open-pit gold mines, however, have excellent potential to allow the gold sector to become a factor in the nation's economy. Development of additional natural resources, such as iron ore, petroleum, and phosphates, has the potential to provide additional jobs and foreign exchange revenue for the country.

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Office National des Ressources Minières
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TABLE I
NIGER: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Cement, hydraulic		29,200	29,200	30,000	30,000	30,000
Coal, bituminous		133,500	133,500	135,000	140,000	140,000
Gold		1	1	1	1	1
Gypsum		1,700	1,700	1,800	1,800	1,800
Molybdenum concentrate, Mo content		10	10	10	10	10
Salt	thousand metric tons	3	3	3	3	3
Tin, mine output, Sn content		20	20	20	10	10
Uranium 3/		2,914	2,975	2,970 r/	3,320 r/	3,463

r/ Revised.

1/ Includes data available through June 1998.

2/ In addition to the commodities listed, phosphate, tungsten, and a variety of construction materials (clays, limestone, sand and gravel, and stone) were produced; but information was inadequate to make reliable estimates of output.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

NIGERIA

By Philip M. Mobbs

Nigeria was Africa's largest oil producer in 1997. According to the U.S. Department of Energy (Energy Information Administration, May 1998, Monthly energy review—international energy, accessed June 23, 1998, at URL http://www.eia.doe.gov/emeu/mer/contents.html), Nigeria ranked ninth in world production of crude petroleum by volume, accounting for about 3% of world production and about 8% of the Organization of Petroleum Exporting Countries' total production. The oil sector remained the cornerstone of the Nigerian economy, providing about 80% of total Government revenues and accounting for about 98% of the country's total export earnings (Africa Business Information Services, 1997, Exports & imports, accessed June 11, 1998, at URL http://www.afbis.com/nigeria/data/exports.htm).

Despite recurrent disruptions in the availability of petroleum fuels and electrical energy, Nigeria's gross domestic product was reported to have grown by an estimated 3.8% in 1997 compared with a 3.3% growth rate in 1996, and inflation increased at an annual rate of 28% in 1997 compared with an escalation of 29% in 1996 and a 73% jump in 1996 (Goldman, 1997a; OPEC Bulletin, 1997a; Africa Business Information Services, 1997, A "policeman" for the Nigerian economy, accessed on June 11, 1998, at URL http://www.afbis.com/nigeria/neic.htm; Anayo Korie, April 21, 1997, Joint venture funds stall activities of oil firms, accessed April 25, 1997, via URL http://www.nigeriangalleria.com/news/xprsnws.htm). During 1997, the Government's income was adversely affected by the decreasing oil prices. Spot prices for Bonny Light, one of Nigeria's crude oil exports, averaged $19.40 per barrel in 1997 compared with $21.24 per barrel in 1996 (Middle East Economic Survey, Spot quotations for the OPEC reference basket, accessed July 7, 1998, at URL http://www.mees.com/dotcom/opec_basket).

Several laws and associated regulations and amendments addressed mineral operations, including the Nigerian Coal Corporation Act of 1950, the Explosives Act of 1964, the Tin Act No. 25 of 1967, the Quarries Act of 1969, the Nigerian Mining Corporation Act of 1972, the Gold Trading Act of 1990, and the Investment Promotion Decree of 1995. Additional legislation, including the Oil Pipelines Act of 1956, the Land Use Act of 1978, the Associated Gas Re-Injection Act of 1979, and the Oil Mineral Producing Areas Development Commission Decree of 1992, regulated petroleum and natural gas operations. Environmental guidelines or regulations included the Federal Environmental Protection Agency Act of 1988, the Effluent Limitation Regulations of 1991, the Pollution Abatement Regulations of 1991, the Pollution Control Guidelines of 1991, the Solid and Hazardous Waste Regulations of 1991, the Environmental Impact Assessment Decree of 1992, the Federal Environmental Protection Agency (amendment) Decree of 1992, and the Harmful Waste Act of 1992.

Nigeria exported about 244 million barrels of crude oil to the United States, its largest customer, in 1997. Accounting for 8% of the United States total crude oil imports, Nigeria trailed only Venezuela, Mexico, Saudi Arabia, and Canada in order of volume (Energy Information Administration, May 1998, Monthly energy review—Petroleum, accessed June 25, 1998, at URL http://www.dia.doe.gov/emeu/mer/contents.html). Nigeria also exported gemstones, liquefied petroleum gas (LPG), refined petroleum products, and tin.

The Ministry of Solid Minerals Development was involved in the promotion, exploration, and development of Nigeria's solid minerals. *(See table 1.)* The Ministry of Petroleum Resources concerned itself with the oil and natural gas segment of the mineral industry. The Ministry of Power and Steel administered the iron and steel sector. Environmental regulations were administered by the Federal Environmental Protection Agency and the Department of Petroleum Resources of the Ministry of Petroleum Resources.

All mineral rights were held by the Federal Government, which encouraged the diversification of the mineral industry. All minerals with significant production were produced by state-owned companies or joint-ventures with the military Government. *(See table 2.)* Decades of the Government's indifference to the nonfuel mineral industry resulted in widespread unregulated artisanal mineral operations (Post Express, February 27, 1997, TACCIMA calls for exploration of mineral deposits, accessed April 25, 1997, via URL http://www.nigeriangalleria.com/news/xprsnws.htm). The Ministry of Solid Minerals Development was trying to resuscitate national production of barite, coal, kaolin, gold, iron ore, marble, and tin, and to formalize operations at deposits that had been developed by unlicensed small-scale miners. The Ministry also was attempting to introduce new mineral resource development, such as salt production. The Nigerian Minerals Appraisal and Monetisation Program (NIMAMOP) successfully increased the awareness of local government officials of their mineral resources. Behre Dolbear & Co. Inc. of the United States, AMTEC International Ltd. of France, and Global Minerals Ltd. of Nigeria, as the NIMAMOP consortium, completed a data base of mineral deposits in Nigeria.

The Aluminum Smelter Co. of Nigeria started one potline of the two-potline, 193,000-metric-ton-per-year (t/yr) smelter at Ikot Abasi, Cross River State, late in the year. The plant was powered by natural gas. Reynolds Metals Co. of the United States was to purchase about 153,000 t/yr of the plant's primary aluminum production. After test runs were completed, output of the one potline had reached 16% of its capacity by yearend (Reynolds Metals Co., 1998, Form 10-K for year ending December 31, 1997,

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accessed June 11, 1998, at URL http://www.sec.gov/Archives/edgar/data/83604/0000083604-98-00008.txt).

Delta Steel Co. Ltd. at Aladja, near Warri, remained idle in 1997. Nigeria's Minister of Power & Steel was negotiating with the Chinese Government to lease the Delta Steel complex.

The National Fertilizer Co. of Nigeria Ltd. closed its 1,000-metric-ton-per-day (t/d) ammonia plant for a 3-month maintenance program in August. The plant's 1,500-t/d urea facility also was shut down for a 5-month overhaul. The Government's October 1997 deregulation of fertilizer distribution and pricing could create more favorable market conditions for the refurbished plant.

The Ministry of Solid Minerals Development complained that oilfield drilling-fluids companies were thwarting national efforts to encourage barite production. Nigerian barite was blended with higher grade imported material to achieve API specifications. Unfortunately however, shipments of local lower-than-anticipated specific gravity barite were spurned by the blenders (Post Express, March 30, 1998, Solid Minerals Ministry slams barytes miners, accessed June 12, 1998, at URL http://www.postexpresswired.com/postexpress.nsf/cae9a9be809d4d8a85256436005cf58e/c0d09395c3ece6d1852565d7004cbc2a?OpenDocument).

The traditional lack of natural gas demand in Nigeria was slowly beginning to change. The Chevron Nigeria Ltd. (40% equity interest) and Nigeria National Petroleum Corp. (NNPC) (60% equity interest) joint venture completed the $569 million LPG extraction plant at Escravos and began shipping LPG via a floating storage and offloading vessel in September. The onshore gas plant had the capacity to process 1.9 billion cubic meters per year of natural gas from the Okam and the Mefa Fields. The plant was designed to recover 2.9 million barrels per year of propane and butane gas for export. An additional 700,000 barrels per year of condensate were projected to be recovered from the gas stream and mingled with crude oil at the Escravos tank farm (Yahoo Finance, September 29, 1997, Chevron sees delay in Nigerian gas project, accessed September 30, 1997, at URL http://biz.yahoo.com/97/09/29/chv_y0024_2.html). The plant's 1.5 billion cubic meters per year of dry gas output were earmarked for the Nigeria Gas Co. When the plant opened, Nigeria Gas could only resell dry gas at the rate of 1.3 million cubic meters per day (Mm^3/d). By yearend, sales to the national electricity generating company had increased to 2.9 Mm^3/d (a rate of 1 billion cubic meters per year). Despite being forced to flare processed gas that Nigeria Gas did not take, Chevron was encouraged and planned to increase the gas plant's input capacity to almost 3 billion cubic meters per year (Yahoo Finance, December 17, 1997, Chevron Nigeria LPG plant reaches capacity, accessed December 18, 1997, at URL http://biz.yahoo.com/971217/nigeriagas_1.html). Mobil Producing Nigeria Unlimited and Shell Petroleum Development Co. of Nigeria also were building gas-processing plants in the delta region.

Construction of the Nigeria Liquified Natural Gas Ltd. (NLNG) facility was nearly 60% completed at yearend. NLNG's 5.78-million-metric-ton-per-year-capacity[1] liquefied natural gas (LNG) liquefaction plant at Finima on Bonny Island is slated to begin LNG deliveries in October 1999 to Botas of Turkey, Enagas of Spain, and Gaz de France. In December 1996, ENEL SpA., the Italian electrical utility, announced the unilateral cancellation of its 20-year take-or-pay contract for about one-half of NLNG's annual output. After lengthy negotiations, ENEL agreed to allow its contracted LNG allocation to be delivered to Gaz de France's Atlantic coast terminal at Montoir en Bretagne. In return, Gaz de France was to supply ENEL with natural gas of an equivalent heating value (Betts, 1997; Petroleum Economist, 1997).

Production of crude petroleum increased slightly in 1997. Most production was from onshore fields in the delta of the Niger River, augmented by offshore wells. Oil exploration activity had moved offshore, with increasing emphasis being placed on deep-water ventures.

New offshore oilfields coming on-line in 1997 included the Ima Field (formerly the Ngo Prospect) of Abacan Resources Corp. of Canada and Amni International Petroleum Development Co. Ltd. of Nigeria and the Ukpokiti Field of Conoco Energy Nigeria Ltd., Express Petroleum and Gas Co. Ltd. of Nigeria, and Camac International (Nigeria) Ltd.

In June, Ashland Nigeria Exploration Ltd., a subsidiary of Ashland Inc. of the United States, sold its production-sharing contracts (PSC) in Nigeria to Perenco S.A. of France. The Nigerian Government proceeded to cancel the PSC licenses, citing the lack of the Government's written consent to the transfer (OPEC Bulletin, 1997b). The issue remained under negotiation for the remainder of 1997.

Nigeria had four oil refineries with a combined throughput capacity of 445,000 barrels per day. The refineries were inactive or produced below capacity. Refinery problems were attributed to various causes, including deferred maintenance (Arab Oil & Gas, 1997). Additionally, product pipelines to population centers in the interior were damaged repeatedly when fuels were illegally diverted from the pipelines (Anayo Korie, April 21, 1997, Joint venture funds stall activities of oil firms, accessed April, 25, 1997 via URL http://www.nigeriangalleria.com/news/xprsnws.htm). Banned by the Government in September 1996, importation of petroleum products was resumed in June 1997 because of the nationwide fuel shortages and resultant civil unrest. Negotiations were underway between NNPC and a subsidiary of Total S.A. of France concerning the renovation of the Kaduna refinery.

The Government estimated that oil reserves were about 125 billion barrels (Abuja Mirror, October 1, 1997, Oil reserve hits 125 billion barrels, accessed April 3, 1998, at URL http:// www.ndirect.co.uk/~n.today/mcover26.htm).

Oil and gas operations were intermittently disrupted. Segments of the population of the coastal delta region who felt they were not benefiting from local petroleum production directed a wide range of demands at local and foreign mineral companies for better living conditions, electricity, employment, flood walls, road building, schools, and potable water supply (Yahoo Finance, December 19, 1997, Focus—Shell hit by rash of attacks in

[1]Upon regasification at the discharge terminals, the proposed annual plant output will be equivalent to 7.15 billion cubic meters of natural gas.

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The Nigerian railway system consists of 3,510 kilometers (km) of 1.067-meter-gauge track. The two main north-south lines, from Lagos to Kano (1,126 km) and from Port Harcourt to Maiduguri (1,443 km), were connected by a 179-km east-west line from Kaduna to Kafanchan. The China Civil Engineering Construction Corp. of the Chinese Ministry of Railways began a $250 million 30-month rehabilitation of the railroad. Maintenance or renovation was begun on the rail lines, including the Ajaokuta-Itakpe line. New locomotives and rolling stock also were imported from China.

Roads, which totaled about 143,000 km, were generally in poor condition because they were heavily used and poorly maintained. Mineral commodities were also transported on the navigable inland waterways, which totaled about 9,000 km mainly on the Niger and the Benue Rivers. Major ports from west to east included Apapa and Tin Can Island in Lagos, Koko near Warri, Port Harcourt, and Calabar. The major petroleum terminals were at Bonny, Brass River, Escravos, Forcados, Kwa Iboe, Odudu, and Pennington.

Petroleum is expected to continue to dominate the Nigerian economy for the foreseeable future, despite continued decreases in funding of NNPC by the Government. In 1997, NNPC's Government-approved budget was for about 40% less than was requested to fund joint ventures. NNPC's repeated postponement of payments for its share of joint-venture operations could adversely affect the Government's target of increasing crude oil production by 50% by the turn of the century (Corzine, 1997). Planned petroleum-exploration and field-development projects were being suspended or prolonged because of NNPC's inability to fund its share of the projects (Anayo Korie, April 21, 1997, Joint venture funds stall activities of oil firms, accessed April 25, 1997, via URL http://www.nigeriangalleria.com/news/xprsnws.htm).

The Government has proposed to eliminate natural gas flaring by 2010. With the development of local industrial markets and LNG exports, natural gas could eventually approach oil's importance to the Nigerian economy. The utilization of Nigerian natural gas could provide a reliable energy source for the West African region and a feedstock for the Nigerian chemical and petrochemical industries.

Development of nonfuel minerals would significantly broaden the country's industrial base. The Government's fiscal and financial incentive programs are designed to attract local and foreign investments in the mineral industry and the Ministry of Solid Minerals Development energetically advocated new mineral investment opportunities in Nigeria. The country's reputation for civil strife, corruption, fraud, political uncertainty, poor infrastructure, and the threat of international sanctions has apparently tempered international investor's interest (Ayittey, 1998; Economist, 1996; Goldman, 1997b; Knott, 1997; Metal Bulletin, 1997; Rupert, 1998; Wall Street Journal, 1997; Washington Post, 1997; Mojeed Jamiu, May 7, 1998, Expected rebound of economy still a mirage, Lagos Concord, transcription from Foreign Broadcast Information Service, May 14, 1998, accessed June 10, 1998 at URL http://fbis.fedworld.gov).

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Nigerian National Petroleum Corporation
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TABLE 1
NIGERIA : PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996 e/	1997 e/
METALS						
Columbium and tantalum concentrates: e/						
Gross weight		40	30	65 r/ 3	57 r/ 3	60
Columbium content		17	17	26 r/	23 r/	23
Gold	grams	1,400	4,800	5,000 e/	6,000	6,000
Iron and steel: e/						
Iron ore, gross weight	thousand tons	400	400	168	100	50
Steel, crude	do.	150	105 3/	36	20	--
Lead, metal, refined e/	do.	5	4	4	4	4
Tin:						
Mine output, cassiterite concentrate:						
Gross weight e/		200	278	357 r/ 3	139 r/ 3	150
Sn content		175	185	250 e/	100	100
Metal, smelter		169	179	259 r/	100 r/ 3	100
INDUSTRIAL MINERALS						
Barite		--	--	--	--	4,000
Cement, hydraulic e/	thousand tons	3,200	2,600 3/	3,000	4,000 r/	6,000
Clays:						
Kaolin		1,300 e/	105,000	11,950 r/	102,078 r/ 3	100,000
Unspecified e/		60,100	104,000	100,000	100,000	100,000
Feldspar e/		700	1,000	3,722 r/ 3	800 r/ 3	1,000
Gypsum e/		10,000	10,000	150,000 r/ 3	383,250 r/	300,000
Nitrogen: e/						
N content of ammonia	thousand tons	270 r/	200 r/	170 r/	164 r/	134
N content of urea	do.	300 r/	200 r/	100 r/	114 r/	41
Stone:						
Limestone	do.	1,400 e/	2,700	3,128 r/	2,095 r/ 3	2,000
Marble	do.	3	8	67 r/	29 r/ 3	30
Shale	do.	195	32	500 e/	500	500
Topaz	kilograms	834 4/	1,022 4/	1,000 e/	1,500	1,500
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/		50,000 r/	130,000 r/	29,000 r/ 3	7,116 r/ 3	7,000
Gas, natural: e/						
Gross	million cubic meters	31,300	34,000	35,000	37,000	40,000
Dry	do.	2,600	4,600	5,000	6,000	7,500
Petroleum:						
Crude	thousand 42-gallon barrels	748,000	743,500	740,000	798,620 r/	800,000
Refinery products:						
Gasoline	do.	30,800	23,000	24,900 r/	23,000	13,000
Jet fuel e/	do.	500	500	350 r/	300 r/	200
Kerosene	do.	14,500	12,000	14,200 r/	10,000	8,000
Distillate fuel oil	do.	15,500	22,000	23,000 r/	20,000	10,000
Residual fuel oil	do.	800	20,000	23,000 r/	18,000	12,000
Unspecified	do.	1,000	13,500	21,200 r/	8,000	7,000
Total	do.	63,100	91,000	102,930 r/	79,300	50,200

e/ Estimated. r/ Revised.

1/ Includes data available through June 26, 1998.

2/ In addition to the commodities listed, amethyst, aquamarine, barite, bitumen, diamond, emerald, garnet, granite, gypsum, lead, phosphate rock, sapphire, soda ash, talc, tourmaline, zinc, zircon, and a variety of crude construction materials (stone, sand and gravel) are produced; but information is inadequate to estimate output.

3/ Reported figure.

4/ Exports.

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TABLE 2
NIGERIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Aluminum Smelter Co. of Nigeria (Government, 70%; Ferrostaal AG of Germany, 20%; and Reynolds International of the United States, 10%)	Ikot Abasi	97 1/
Cement		West Africa Portland Cement Co. (Associated International Cement, 39.4%; Odu'a, 26.8%; public, 17.2%; Government, 16.6%)	Ewekoro	750
			Shagamu	600
Coal		Nigerian Coal Corp. (Government, 100%)	Enugu	150
Iron and steel:				
Iron ore		National Iron Ore Mining Co. (Government, 100%)	Itakpe	5,500
Iron		Delta Steel Co. Ltd. (Government, 100%)	Aladja	2,000
Steel		Ajaokuta Steel Co. Ltd. (Government, 100%)	Ajaokuta	1,350 2/
Do.		Delta Steel Co. Ltd. (Government, 100%)	Aladja	1,000 3/
Do.		Jos Steel Rolling Co. Ltd. (Government, 100%)	Jos	210 3/
Do.		Katsina Steel Rolling Co. Ltd. (Government, 100%)	Katsina	210 3/
Do.		Oshogbo Steel Rolling Co. Ltd. (Government, 100%)	Oshogbo	210 3/
Natural gas, liquefied		Nigeria Liquified Natural Gas Ltd. (Nigerian National Petroleum Corp., 49%; Royal Dutch/Shell Group, 26%, Elf Nigeria Ltd., 15%; and Nigeria AGIP Oil Co., 10%)	Finima	5,780 2/
Nitrogen				
Ammonia, nitrogen content		National Fertilizer Co. of Nigeria Ltd. (Government, 63%; M.W. Kellogg Co., 37%)	Onne	300 4/
Urea, nitrogen content		do.	do.	255 5/
Petroleum:				
Crude	million 42-gallon barrels	Shell Petroleum Development Co. of Nigeria and Nigerian National Petroleum Corp. joint venture	Niger Delta	340
Do.	do.	Mobil Producing Nigeria Unlimited and Nigerian National Petroleum Corp. joint venture	do.	200
Do.	do.	Chevron Nigeria Ltd. and Nigerian National Petroleum Corp. joint venture	do.	150
Do.	do.	Nigeria AGIP Oil Co. and Nigerian National Petroleum Corp. joint venture	do.	70
Do.	do.	Elf Petroleum Nigeria Ltd. and Nigerian National Petroleum Corp. joint venture	do.	50
Do.	do.	Texaco Overseas Producing Co. of Nigeria, Chevron Nigeria Ltd. and Nigerian National Petroleum Corp. joint venture	do.	25
Do.	do.	Nigeria Petroleum Development Co. and Consolidated Oil Ltd.	do.	5
Natural gas liquids	do.	Mobil Producing Nigeria Unlimited and Nigerian National Petroleum Corp.	Oso Field	18 2/
Refinery products	do.	New Port Harcourt refinery (Government, 100%)	Port Harcourt	55
Do.	do.	Warri refinery (Government, 100%)	Warri	43
Do.	do.	Kaduna refinery (Government, 100%)	Kaduna	38 6/
Do.	do.	Old Port Harcourt refinery (Government, 100%)	Port Harcourt	22 3/
Tin		Makeri Smelting Co. Ltd. (Government, 100%)	Jos	1

1/ A two-potline 193,000-metric-ton-per-year-capacity smelter is under construction. One potline was operating at yearend.
2/ Under construction.
3/ Idle during 1997.
4/ Closed for maintenance August through November 1997.
5/ Closed for maintenance August 1997 through January 1998.
6/ Closed since July 1997.

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THE MINERAL INDUSTRY OF

RWANDA

By George J. Coakley

The landlocked, 26,340 square kilometer Central African nation of Rwanda is located between Tanzania and the Democratic Republic of the Congo [Congo (Kinshasa)]. In 1997, the population was 7.9 million and the gross domestic product per capita, based on 1996 estimates of purchasing power parity, was $440. The economy was predominantly agrarian with the minerals industry limited to cement production and the mining and export of small quantities of beryl, cassiterite (tin), columbium-tantalum, gold, and wolframite (tungsten) ores. The civil unrest, violence, and population dislocations of the 1990's, culminating in the return of large number of refugees from Tanzania and Congo (Kinshasa) during 1997, have been a disincentive to new foreign investment. The structure of the industry consisted mostly of a number of small cooperatives and individual artisanal miners that produced the concentrates of tin, tungsten, columbium-tantalum, and gold ores from scattered locations, generally in a zone about 30 kilometers wide extending east-west through Kigali. Mineral production data were estimated. (*See table 1.*) Mineral reserves data were not available. For more-extensive coverage of the minerals industry of Rwanda, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
RWANDA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

Commodity		1993	1994	1995	1996	1997
Cement	metric tons	60,300 r/	10,000	10,000	10,000	10,000
Columbite-tantalite, ore and concentrate:						
Gross weight	kilograms	100,000	100,000 r/	149,000 2/	100,000	100,000
Nb content	do.	34,000	34,000 r/	40,000 2/	30,000	30,000
Ta content	do.	22,000	22,000 r/	28,000	25,000	25,000
Gold, mine output, Au content	do.	1,000	1,000 r/	26 2/	25	25
Natural gas, gross	thousand cubic meters	970	970	970	970	100
Tin, mine output, Sn content	metric tons	400	50	242 2/	200	200
Tungsten, mine output, W content	do.	175	30	47 2/	40	40

r/ Revised.
1/ Includes data available through June 25, 1999.
2/ Reported figure.

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THE MINERAL INDUSTRY OF

SENEGAL

By Philip M. Mobbs

Production of phosphate rock, fertilizers, and phosphoric acid continued to dominate the mineral industry of Senegal. Minerals accounted for almost 20% of the country's export earnings and approximately 2% of the nation's gross domestic product. Other mineral resources identified by the Government included clays, copper, diamond, the Tamna Lake diatomite, the Faleme iron ore, peat, additional deposits of phosphate rock at Matam, silica sands, dimension stone in the southeast, titanium-bearing sands along the coast, and uranium (Ministry of Energy, Mines, and Industry, 1995).

For more extensive coverage of the mineral industry of Senegal, see the 1996 Minerals Yearbook, Volume III, Mineral Industries Review of Africa and the Middle East.

Reference Cited

Ministry of Energy, Mines, and Industry, 1995, Mineral Resources Development Investment Opportunities: Dakar, Senegal, Ministry of Energy, Mines, and Industry, 35 p.

TABLE 1
SENEGAL: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Cement, hydraulic	metric tons	589,820 3/	590,000	590,000	590,000	590,000
Clays, fuller's earth (attapulgite)	do.	119,000 3/	119,000	120,000	120,000	120,000
Petroleum:						
Natural gas	thousand cubic meters	110,000	110,000	110,000	110,000	110,000
Crude oilg	thousand 42- allon barrels	4	2	2	2	2
Refinery products	do.	6,200	6,200	2,500	2,500	2,500
Phosphate rock and related products:						
Calcium phosphate-based fertilizers		160 3/	160	160	160	160
Crude rock:						
Aluminum phosphate 4/		29	29	40	40	40
Calcium phosphate		1,667 3/	1,587 3/	1,500	1,340 r/	1,300
Phosphoric acid		274 3/	274	274	300	300
Salt	metric tons	117,400 3/	117,000	120,000	120,000	120,000

r/ Revised.
1/ Includes data available through August 13, 1998.
2/ In addition to the commodities listed, Senegal produced clays, sand and gravel, and stone for local construction purposes, limestone for cement, and artisanal gold. Information is inadequate to make reliable estimates of output levels.
3/ Reported.
4/ Estimated data, based on clinker production reported in 1993.

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THE MINERAL INDUSTRY OF

SIERRA LEONE

By Philip M. Mobbs

Sierra Leone's mineral production remained restricted by civil unrest during most of 1997. The fighting resulted in the suspension of most mineral operations in the country. The mineral industry had accounted for 15% to 20% of the nation's gross domestic product, 80% to 90% of export earnings, and employed almost 15% of the labor force, primarily in rural areas.

Sierra Leone has additional mineral deposits, including bauxite, cassiterite, clays, columbite, diamond, gold, iron ore, kaolin, lignite, platinum, dimension stone, and tantalite (Jeremy Hawke, IMC Mackay and Schnellmann, unpub. data, 1997). For more-extensive coverage of the mineral industry of Sierra Leone, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
SIERRA LEONE: PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Bauxite, gross weight		1,170	735	--	--	--
Diamond	thousand carats	158	255	214	270	104
Gold 2/	kilograms	157	125	4	16	10
Gypsum e/	metric tons	4,000	4,000	100	300	150
Salt e/		200	200	--	50	10
Titanium:						
Rutile ore and concentrate 96% TiO_2, gross weight		152	137	--	--	--
Ilmenite ore and concentrate 60% TiO_2, gross weight		63	47	--	--	--
Zircon	metric tons	--	1,300	--	--	--

e/ Estimated.
1/ Table includes data available through August 14, 1998.
2/ Data includes only officially reported production.

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THE MINERAL INDUSTRY OF

SOMALIA

By Philip M. Mobbs

Continued political instability restricted the contribution of the mineral industry to the Somali economy. Mineral production presumably continued in a limited way during 1997, despite the political situation, because of the artisanal nature of the small marine salt, sepiolite (meerschaum), and crude construction material operations throughout the country. For more extensive coverage of the mineral industry of Somalia, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
SOMALIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1993	1994	1995	1996	1997
Cement, hydraulic	25,000	25,000	25,000	30,000	30,000
Gypsum	2,000	2,000	2,000	2,000	2,000
Limestone 3/	40,000	40,000	40,000	45,000	45,000
Salt, marine	1,000	1,000	1,000	1,000	1,000
Sepiolite (meerschaum)	5	5	6	6	6

1/ Includes data available through August 14, 1998.
2/ In addition to the commodities listed, various crude construction materials (e.g., clays, sand and gravel, crushed and dimension stone) and limestone for lime manufacture and/or agriculture are presumably produced; also clay and/or shale are normally produced for cement manufacture, however, available information is inadequate to make reliable estimates of output.
3/ For cement manufacture only.

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THE MINERAL INDUSTRY OF

SOUTH AFRICA

By George J. Coakley and Thomas P. Dolley

The Republic of South Africa remained one of the world's most important mining and mineral processing nations in 1997. South Africa had the largest production of gold and was the largest or among the dominant producers of many other mineral commodities. Mineral production continued to be the cornerstone of the South African economy. Its gross domestic product (GDP) was about $129 billion, and total exports of all goods were valued at $30.9 billion.[1] Mining accounted for 43% of foreign exchange earnings, 8.1% of the GDP and more than 500,000 jobs. Gold mining alone accounted for about 4% of GDP (Washington Times, 1998). The most important mineral commodities produced in South Africa, in terms of value, continued to be gold, coal, and platinum-group metals (PGM). Additionally, significant output of metallic minerals included ores and/or smelted products of antimony, chromium, iron, manganese, titanium, uranium, vanadium, and zirconium. Important output of industrial minerals included andalusite, asbestos, diamond, dimension stone, fluorspar, phosphate rock, and vermiculite. South Africa was a major producer and the world's third largest exporter of coal. It was also the largest producer of synthetic liquid fuels and petrochemicals derived from coal. South Africa's well-developed railway and port infrastructure served the domestic minerals industry and those in neighboring countries. Summarizing for the year, South Africa produced 55 different mineral commodities from about 695 mines and quarries, including about 61 coal mines, 54 diamond and 53 gold operations. Ongoing corporate restructuring of major mining investment houses in South Africa continued during the year (Mining Journal, 1997; Verster and van Luitingh, 1997; Gcabashe and others, 1998).

In 1997, total sales of primary minerals, as reported by the South African Minerals Bureau, amounted to about $14.2 billion. Export sales of gold were $5.3 billion; coal at $1.8 billion; and PGM $1.8 billion (Gcabashe and others, 1998). South Africa also produced significant amounts of a number of secondary or processed mineral commodities, notably ferroalloys and steel, cement, manufactured fertilizers, and refined petroleum products (from coal and crude petroleum), valued at more than $3.5 billion. Almost 90% of South Africa's electricity was generated from coal and about 6% from uranium (U.S. Energy Information Administration, 1997, South Africa, accessed November 12, 1997 at URL http://www.eia.doe. gov/emeu/cabs/safrica.html).

Government Policies and Programs

The Ministry of Mineral and Energy's Department of Minerals and Energy (DME) was the primary Government entity responsible for the establishment and implementation of minerals and energy policy and for oversight of the country's mineral industry. Within the DME were the Mineral Development Branch, which was responsible for regional mineral development, minerals economics (Minerals Bureau), mine rehabilitation, and mining rights; the Energy Branch, which promoted the optimum utilization of energy resources; and the Mine, Health & Safety Inspectorate. A number of parastatal institutions were associated with DME including: the Atomic Energy Corp., the Council for Nuclear Safety, the Council for Geosciences (formerly the Geological Survey of South Africa), the Council for Mineral Technology (Mintek), the National Electricity Regulator, the South African Diamond Board, and the CEF (Central Energy Fund) Pty. Ltd., through which the State's interest in the liquid fuel industry is owned, developed and managed commercially.

The South African mineral industry as a whole awaited reforms to the tax system and labor reform (Mining Journal Ltd., 1997). It operated under substantially the same laws in 1997 those of 1993. These included the Mining Titles Registration Act, 1967; Mining Rights Act, 1967; Central Energy Fund Act, 1977; Petroleum Products Act, 1977; Nuclear Energy Act, 1993; Diamonds Act, 1986; Electricity Act, 1987; Mineral Technology Act, 1989; Minerals Act, 1991; Minerals Amendment Act, 1993; and the Liquid Fuels and Oil Repeal Act, 1993. A number of these laws were expected to be subject to review during the next few years.

In response to the high accident and death rate in deep gold mining, in particular, the Mine and Safety Act was passed in June 1996 and went into effect on January 15, 1997, with some provisions pending. Under the new law, mine managers were given increased responsibilities for the environmental, health, and safety of the mine and mine labor. By year-end 1997, the DME had not yet officially released its long-awaited Green Paper on a new minerals and mining policy for South Africa. Expectations were that it would promote a positive environment for growth and employment in the mining sector. Government policy debate on the proposed paper also centered on whether to retain private ownership of mineral rights or to vest all rights in the State. In the South African system, a Green Paper represents the first draft of a proposed policy for public review and comment; while a White Paper is the Government Administration's final version submitted for final public review and for consideration for legislation by the Cabinet and Parliament.

Environmental Issues

In August 1995, the Department of Environmental Affairs and

[1]Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R4.61=US$1.00 for 1997.

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Tourism initiated a Consultative National Environmental Policy Process, referred to as CONNEPP, to review the state of the environment in South Africa and to recommend a new environmental policy for the country. Following the receipt of public comment on the October 1996 draft Green Paper, the South African Department of Environmental Affairs and Tourism (DEAT) released its draft White Paper on Environmental Management Policy for South Africa in July 1997. The White Paper states among the tenets of South Africa's New Environmental Policy that "Equitable access to, and ownership and control of, renewable and non-renewable natural resources by South Africans, black and white, poor and rich, male and female, is critical to our survival as a country. Conservation and sustainable use of these environmental resources and their protection depends on changed behavior by all individuals, households, and private and public institutions. These changes must affect processes of resource extraction, spatial development, appropriate and clean production, waste minimization and pollution control strategies in order to guarantee a higher quality of life for all." The paper endorses a "polluter pays" principle. Furthermore the forward of the paper states that "Through this policy government undertakes to give effect to the many rights in the Constitution that relate to the environment. They include rights relating specifically to the environment, as well as those relating to governance such as the legal standing of parties, administrative justice, accountability and public participation. The policy furthermore defines the essential nature of sustainable development as the combination of social, economic and environmental factors. It takes ownership of sustainable development as the accepted approach to resource management and utilization in South Africa, thus entrenching environmental sustainability in policy and practice" (Department of Environmental Affairs and Tourism, July 1997, White Paper on environmental management policy, accessed December 12, 1998, at URL http://www.polity.org.za/govdocs/white_papers/envir.html).

In December 1997, the mining industry provided its comments on the paper that focused on clarification of definitions and enforcement of policies, expressing concerns that the new environmental management system could lead to a costly and "burgeoning bureaucracy" and questioning the operation of a proposed environmental rehabilitation fund and the division of regulatory powers between federal and regional authorities and between DEAT and other federal departments (Chamber of Mines of South Africa, December 1997, Mining industry comments on the draft White Paper on environmental management policy, accessed February 28, 1998 at URL http://www.bullion.org.za/bulza/polcy/eviman.htm).

Production

In 1997, South Africa was one of the largest and most diverse minerals producers in the world. As shown in *table 1*, output levels were mixed. Since 1993, gold production has steadily decreased by more than 20% as a result of declining ore grades and increasing production costs associated with deeper mining. During 1997, world mineral commodity prices, in general, were depressed. In rand value, revenues from the sale of minerals increased significantly, with an exchange rate depreciation of 7% helping to offset lower dollar-based sales. In revenue terms, processed mineral commodities in South Africa have shown increased performance during the past several years, particularly in the export terms. Local sales of minerals have increased significantly (Gcabashe and others, 1998). Domestic mineral commodity sales have been stimulated by a number of major industrial projects and the government's residential home construction program.

Trade

The Minerals Bureau compiles mine production, trade, and value data for most crude or primary minerals and selected processed mineral products. The following data are from the Minerals Bureau, unless otherwise indicated.

Primary mineral exports were about 37% of the total value of all exports. The contribution of mining to total export revenues has declined as the manufacturing sector of the economy has expanded during the past decade. The Minerals Bureau estimated that the inclusion of the various processed mineral products, such as ferroalloys and steel, would raise the contribution of the minerals sector to more than 50% of total export revenues.

In 1997, primary mineral exports were led by gold, valued at $5.3 billion. Following gold, the most valuable crude mineral exports were coal valued at $1.8 billion and PGM valued at $1.8 billion. Other mineral exports were iron ore, at $351 million: copper, at $165 million; nickel, at $132 million; and manganese ore, at $125 million. Although individual data were officially withheld, exports of diamond, titanium, and zirconium minerals accounted for most of the $2.8 billion reported by the Minerals Bureau as "miscellaneous" mineral exports. Other mineral exports were chrome ore valued at $91 million and lead valued at $33 million.

In the value-added sector, 1997 exports of processed ferroalloys included chrome alloys valued at $739 million and manganese alloys valued at $367 million. Some of the major destinations by value for primary mineral exports, including precious minerals, were Europe at 85.5%; the Pacific Rim Countries, 9.5%; Middle and Near East, 2.2%; and North America and Central America, 1.0%. Exports within Africa in accounted for less than 1% of South African mineral export trade. With the end of economic sanctions, intra regional trade was expected to increase although the markets remain small compared to other trading regions (Gcabashe and others, 1998).

Although South Africa was self-sufficient in the vast majority of its mineral needs, some mineral commodities were imported. Significant mineral imports included, alumina, coking coal, rough and cut diamonds, certain ferroalloys, magnesite, magnesia, nickel, precious metals, and sulfur.

Structure of the Mineral Industry

The South African minerals and energy industries operated on a free enterprise, market-driven basis. Ownership of mineral rights was held either by the Government or private entities.

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Government involvement in these sectors was minimal and was primarily confined to ownership of the national electric utility, Eskom, and the national oil and gas exploration company, Southern Oil Exploration Co. (Soekor), including additional declining subsidies provided to synthetic fuels programs of the parastatals, Mossgas (Pty) Ltd. and Sasol. With the end of economic sanctions and freer access to world petroleum supplies, state subsidies were being phased out.

In South Africa, the bulk of mineral land holdings and production has been historically controlled by five mining investment houses—Anglo American Corporation (AAC) including Johannesburg Consolidated Investment Limited (JCI), Gold Fields of South Africa (GFSA), Gencor Limited (formerly General Mining and Finance Corp.), Rand Gold and Exploration Co., (formerly Rand Mines), and Anglovaal Limited. These houses also historically had major holdings in most other sectors of the South African economy. Since 1994 the industry has been undergoing a major corporate restructuring or "unbundling"to simplify a complex system of interlocking ownership, to establish separate core-commodity-focused profit centers, and to diversify and rationalize nonperforming assets to make the newly restructured companies more competitive internationally.

In 1997, the major mining houses continued to divest themselves of their nonmining subsidiaries. The declining price of gold has helped accelerate this process. In November 1997, JCI Ltd.'s major gold mines of Western Areas and H.J. Joel, also owned by AAC, were merged into Anglogold, thus creating the world's largest gold company with an annual production of 6 million troy ounces [186,600 kilograms (kg)] of gold and gold reserves, in all categories, of 140 million troy ounces [5,354 metric tons (t)]. In 1996, AAC had renamed the company's gold and uranium division "Anglogold Limited."

In 1996, Anglovaal Limited divided its assets into Anglovaal Minerals (Avmin Limited), which was to manage all of Anglovaal's strategic mineral and mining investments, and Anglovaal Gold (Avgold Limited), which was to manage most of Anglovaal's gold properties and exploration activities.

In May 1995, AAC had unbundled its holdings in JCI into three separate companies—JCI Limited, with interests in coal, ferrochrome, gold, and base metals; Anglo American Platinum Corporation Limited (Amplats), with interests in platinum mining and processing, and Johnnies Industrial Corp. (Johnnic), containing its nonmining industrial holdings. JCI Limited was subsequently sold off to a black empowerment group, African Mining Group controlled by Capital Alliance. When the company ran into operating difficulties in 1997, the decision was made to break up JCI Limited. In September, JCI Limited was restructured into two autonomous companies, JCI Projects Limited for its base metal assets and JCI Gold Limited for its gold assets. The gold assets, including H. J. Joel, Randfontein Estates, and Western Areas, were collapsed into JCI Gold. In November, JCI Limited sold back to AAC 60% of its interests in the H. J. Joel gold mine and 36.8% of Western Areas gold mines and remaining interests in Amplats in exchange for the 26% interest of De Beers Consolidated Mines Limited (De Beers) and AAC in Lonrho Plc of the United Kingdom.

The megamerger of the gold assets of GFSA and Gencor was announced in October 1997 and finalized on February 2, 1998, creating Gold Fields Ltd., the world's second largest gold producer with an annual production of 3 million troy ounces (93,300 kg) of gold and gold minable resources of 81.6 million troy ounces (2,538 t). Operations were consolidated in South Africa under the Beatrix, the Kloof and Dreifontein Consolidated Ltd., the Oryx, and the St. Helena Divisions and in Ghana at the Tarkwa Mine. Gold Fields also retained the technical rights to the BIOX gold biological leach process. Gencor, which had previously consolidated all its nonprecious metal holdings into the London-based Billiton Plc was left with Impala Platinum Limited (Implats), the second largest platinum producer in the world, as its only direct mining asset (Gold Fields Limited, 1998, The creation of Gold Fields Limited, accessed May 8, 1998 at URL http://www.goldfields.co.za/announce.asp).

Rand Gold and Exploration Co., formed in July 1997 from Rand Mines to acquire and rehabilitate marginal cost mines, restructured its holdings into Durban Roodeport Deep Ltd. (DRD) and into the London listed Randgold Resources Ltd. DRD operated the Durban Roodeport Deep, the East Rand Proprietary (ERPM), and the South Wits deep extension gold mines in South Africa. The Durban Roodeport Deep mining group represents the 1997 merger of three West Rand gold mines—Blyvooruitzicht, Buffelsfontein, and Durban Deep. Harmony Gold Mining Co. Ltd. was spun off by Rand Gold and Exploration Co. in 1997 as an independent company.

The Chamber of Mines, whose members represent the majority of coal, gold, and uranium producers, was responsible for a variety of advisory and service functions for mining interests in South Africa. One of its main activities was the annual wage negotiations between member mines and the National Union of Mineworkers.

The largest foreign-owned mining group operating in South Africa was Rio Tinto Plc. of the United Kingdom, which jointly owned the Palabora copper mine in northeastern Transvaal, one of the largest copper mines in the world, with AAC. Rio Tinto was also a 50% shareholder in Richards Bay Minerals Ltd. (RBM), a major world producer of mineral sands, with operations in the coastal areas of KwaZulu-Natal Province.

According to the Minerals Bureau, the overall South African mining industry employed an average of 551,677 workers compared with 541,100 employees in 1996. Employment in the mining industry represented about 3.8% of the country's economically active population. The gold industry was the largest employer within the mining sector with 322,000 workers, or 62% of total employees in the sector. Total remuneration paid to the mining workforce in 1997 was 18.1 billion rands, equivalent to $3.9 billion.

Commodity Review

Metals

Aluminum.—Because South Africa has no economically exploitable deposits of bauxite and no alumina production capacity, all alumina feedstock for the production of aluminum metal is imported. Aluminum South Africa (Pty.) Ltd. (Alusaf)

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was the sole producer of primary aluminum from its Bayside smelter and the newer Hillside smelter, at Richards Bay. Production of aluminum metal increased by about 15% to 673,000 t, in 1997. In its second year of full production, Alusaf operated the Hillside smelter at 2% to 3% above its design capacity of 490,000 t. Aluminum output from the Hillside smelter was intended for the export market, and that from the Bayside smelter for the domestic market. South Africa's aluminum exports for 1997 totaled 567,000 t (Joseph, 1998a).

Antimony.—Consolidated Murchison Ltd.'s operation at Gravelotte was South Africa's only producer of antimony (as stibnite concentrate); its output made South Africa the fourth largest producer after China, Russia and Bolivia. In 1997, the world market price for antimony metal declined dramatically owing mainly to global oversupply. For 1997, South African antimony concentrate production declined by more than 33% compared with that of 1996; declining ore grades and amount of tonnage milled were major factors.

In other developments, JCI Limited sold its 33.1% interest in Consolidated Murchison to Metorex (Pty.) Ltd., affiliated with Canada's Crew Development Corp. During the year, Consolidated Murchison suspended development of the Beta Shaft project at the Gravelotte operation, citing lackluster projections for antimony prices. The company did not rule out future reevaluation of the project (Joseph, 1998b).

Chromite.—Chromite ore production increased significantly during the year, fueled by global demand for its use in stainless steel production. South Africa was the global leader in chromite ore production and export. Production came from more than 20 mines located within the Bushveld Ultramafic Complex. About 22% of the ore was exported, and the remainder went to supply domestic ferrochrome smelters. Domestic consumption of chromite ore was the highest in the world, feeding the world's leading ferrochrome industry, as well as a world-class chromium chemicals and refractories industry. Chromite ore sales were valued at about $206 million in 1997, of which $91 million was export revenue (Bates, 1998a). Further details on the South Africa chromite and ferrochromium industry in 1997 are available in the 1997 U.S. Geological Survey Minerals Yearbook chapter on chromium accessible at URL http://minerals.usgs.gov/minerals/pubs/commodity/chromium/).

Copper.—Copper production in South Africa increased marginally in 1997, reflecting the falling global demand for copper in the second half of 1997. Palabora Mining Company Limited, by far the largest copper producer in the country, treated 28.8 million metric tons (Mt) of ore grading 0.55% copper for the year, yielding 133,662 t of copper in concentrates. Processed output included 119,042 t of copper. Palabora also produced 13,500 t of baddeleyite (70% of world demand), 343 t of nickel sulfate, 87,070 kg of uranium oxide, 207,070 t of vermiculite concentrates, and 9,387 t of zirconium dioxide chemicals, as well as 15,546 kg of precious metals contained in refinery tankhouse slimes. The Palabora mine also generated 183,600 t of byproduct magnetite concentrates grading 65.5% iron and 1.6% titanium dioxide, which were either sold to the coal-washing industry or stockpiled for possible future use in a proposed new hot briquetted iron facility in Mozambique. Development of production and service shafts reached 816 and 997 meters respectively, in anticipation of transitioning from open-pit to underground mining in 2002. The $440 million underground development project will extend the life of the mine for another 20 years, with production at a rate of 30,000 metric tons per day of copper ore (Palabora Mining Company Limited, 1998).

O'okiep Copper Co., owned by GFSA, operated a copper mine and smelter located near Springbok, Northern Cape Province. As one of the oldest mining districts in South Africa, aboriginal copper mining in the Province pre-dates 1685, and modern mining dates to 1846; O'okiep was formed in 1937. Since 1937, twenty-three different copper mines have been worked and depleted; the Carolusberg Mine was the most recent closure (1997). The Nigramoep Mine, the only ore body being mined in 1997, used a modified vertical crater retreat mining system to mine 65,000 metric tons of ore per month (t/mo). During 1997, the mine milled 863,364 t of copper ore grading 1.7% copper, with a mill recovery rate of 89%. Contained copper in concentrates amounted to 13,070 t, with a concentrate grade of 42.23% copper. The O'okiep smelter, located at Nababeep, had the capacity to produce 42,000 metric tons per year (t/yr) of blister copper, about half of which came from Nigramoep concentrates. Additional smelter feed has been supplied by concentrates from the Prieska copper mine in South Africa and the Otjihase copper mine in Namibia. Copper was also produced in small amounts as a byproduct of lead-zinc and platinum mining.

Gold.—Faced with dropping ore grades and the increasing cost of deep mining, the gold industry continued its steady decline. In 1997, mine production was 492 tons of gold with an average grade per ton milled of 5.09 grams (g) of gold. This was only about 1% lower than that of 1996, but significantly lower than the historical peak production year of 1970 when 989 t of gold was produced at an average grade per ton milled of 13.28 g of gold. South Africa remained the world's leading gold producer, although its once-dominant share of total global new mined gold production dropped to 12% in 1997 from 68% in 1970. In a similar trend based on Chamber of Mines data, employment levels in the gold industry have also declined to 322,000 workers in 1997, compared to 344,000 in 1996 and 522,000 in 1987 (Chamber of Mines of South Africa, 1998, Online statistical tables—1997/98, accessed February 20, 1999, at URL http://www.bullion.org.za/panl/wmain2.htm). Low world gold prices, as well as restructuring and streamlining of the South African gold industry and increased mining costs, contributed to decreased gold output.

For Chamber members, working costs (in rands) rose by about 10% per metric ton of ore milled and 9% per kilogram of gold recovered in 1997. Increases reflected generally high inflation levels, including higher wages, and, notwithstanding labor-intensive mining methods, the great technical difficulties of mining at extreme depths. The number of gold mines in a marginal position increased to nine in 1997, from seven mines in 1996, owing to a decline in profitability (Chamber of Mines of South Africa, 1998, Annual report 1997/98: "Regeneration"—

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Economic Review: 1997 section, p. 61, accessed October 12, 1998 at URL http://www.bullion.org. za/bulza/pgs/onlpub.htm).

The continued unbundling of assets by major South African mining companies was the main highlight for the gold industry during the year.

Iron and Steel.—Iron Ore.—In 1997, Iron ore production in South Africa increased owing primarily to increased demand by steel producers and the elimination of bottlenecking and capacity constraints on the 861-kilometer (km) railway line from Iscor Ltd.'s Sishen Mine to the port at Saldanha Bay. Iron ore exports, primarily hematite, amounted to about 20.7 Mt, worth about $347 million (Grobler, 1998a).

Iscor was South Africa's largest iron ore producer. Its two iron mines, Sishen and Thabazimbi—accounted for about 80% of the country's total output. In 1997, the Sishen Mine produced 21.6 Mt iron ore and the Thabazimbi Mine 2.6 Mt. Sishen contains about one-half the world's known reserves of lumpy iron ore, grading 65% iron. Iron ore grades from the Thabazimbi Mine are about 60% (South Africa Minerals Bureau, 1996; Grobler, 1998a).

Steel.—South African crude steel production dropped in 1997. Iscor's production dropped to 6.48 Mt but still accounted for more than 80% of the country's total crude steel production. Iscor remained the largest steel maker in Africa.

Despite a strike in late 1997, Saldanha Steel (Pty) Ltd., an independently incorporated company equally owned by Iscor and the Industrial Development Corporation of South Africa (IDC), was on schedule to commission its new $1.5 billion plant at Saldanha Bay in late 1998. The plant will be the world's first steel minimill to combine Corex and Midrex iron and steelmaking technologies and was being designed as an environmentally clean facility (Saldanha Steel (Pty.) Ltd, 1998, Saldanha Steel, accessed December 12, 1998 at URL http://www.ssteel.co.za). Production at full capacity of 1.25 million metric tons per year (Mt/yr) of hot-rolled steel coil was expected by the end of 1999; the plant layout was designed so that this capacity can be doubled in the future. Approximately two-thirds of production will be exported as hot-rolled coil, with the remaining one-third sent to the new adjacent Duferco Steel Processing Ltd. cold rolling slab plant where it will be cold rolled into thinner slabs. The Duferco processing will also include pickling, oiling, and galvanizing stages.

Ferroalloys.—During the year, ferrochromium production increased to about 1.9 Mt. Total export volume for South African ferrochrome exceeded 1.7 Mt, valued at $739 million. Other ferroalloy production, reported by the Minerals Bureau, included 824,997 t of manganese alloys valued at $414.5 million, of which 87.3% was exported, and 102,152 t of ferrosilicon valued at $79.1 million, of which 46.5% was exported. In addition, 34,000 t of silicon metal valued at $48.7 million was produced.

Manganese.—South Africa possessed the world's largest resources of manganese ore, reported to be 12 billion metric tons, and challenged China as the world's largest producer (Samancor, 1998, Manganese: Ores, accessed at URL http://www.samancor.co.za/home.htm). In 1997, South Africa produced 3.12 Mt gross weight of manganese ore and concentrates, primarily metallurgical grades ranging from 30% to more than 48% manganese. Samancor accounted for about two-thirds of national production from its Mamatwan open pit and Wessels underground mines, near Hotazel. The Associated Manganese Mines of South Africa Ltd. (Assmang), controlled 50.2% by Anglovaal Minerals (Avmin), is the other major producer, with sales of 1, 146,000 t in 1997. Both companies have downstream ferromanganese and silicomanganese processing facilities. Additional information on chromite and manganese mine and ferroalloy production in South Africa is available through a Minerals Bureau special publication (Bates and Armitage, 1998).

Nickel.—South Africa's nickel production was in the form of metal, metal-in-concentrate, and sulfate. The nation's nickel output was mostly a byproduct of PGM production, with some byproduct production from the Palabora copper mine. In 1997, output increased owing to the production startup at South Africa's first primary nickel mine, the Nkomati Joint Venture. Nkomati, controlled by Avmin (75%), brought the $ 35 million MSB Mine, a small, high grade portion of the area nickel resource, into production in January at a rate of 10,000 t/mo run-of-mine ore, yielding 3,000 t/mo of concentrate containing an average of 210 t nickel, 67 t copper, 4 t cobalt, 4.9 kg platinum, and 14.4 kg palladium. The feasibility study on developing three adjacent orebodies was continuing (Avmin Ltd., 1997). Domestic sales of nickel amounted to about $86 million, and South Africa's export of nickel was valued at more than $132 million (Damarupurshad, 1998a).

Platinum-Group Metals.—South Africa's production of PGM, which originated almost exclusively from mines in the Bushveld Complex, north of Pretoria, has increased by more than 4% per year during the past 10 years, and has continued to be the world's largest. Additionally, South Africa possessed more than 55% of identified global resources of PGM.

For 1997, production of PGM in South Africa increased to 196,466 kg, an increase of 4.1% from that of 1996. Of the 1997 South African PGM production total, platinum accounted for 58%, and palladium accounted for 28.6%. Reduced output of PGM from Russia helped stimulate South African production. Total sales revenues for PGM were valued at about $1.8 billion (*table 1*). Global production and price of iridium increased during the year because of its growing use in iridium-containing alloys in automobile exhaust catalysts. As PGM production continued to expand in South Africa, increased production of all these closely related metals can be expected (Lourens, 1998).

Amplats was the largest PGM producer in the world at about 37% of global platinum supply, all from South African operations. In 1997, Amplats announced the development of a new PGM mine, the Bafokeng Rassimone, in the western part of the Bushveld Complex. It expected the new mine to reach full production in 2002 (Lourens, 1998). South Africa's other dominant platinum producer was Implats.

Titanium and Zirconium.—Globally, South Africa ranked second in titanium production and third in titanium exports in

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1997. Titanium slag production in South Africa showed a marginal increase during the year. RBM, owned jointly by Rio Tinto and Billiton, produced ilmenite, rutile, and zircon from beach sands north of Richards Bay. Richards Bay Iron and Titanium (Pty.) Ltd., a sister company, produced an 85% titanium dioxide slag from ilmenite concentrates at the Richards Bay smelter, as well as low-manganese pig iron. RBM was the largest titanium mineral producer in the country and produced about 980,000 t in 1997. Titaniferous magnetite also was recovered at the Phalaborwa carbonatite as a byproduct of copper and phosphate rock production, and titaniferous slag was produced with magnetite ores from Highveld Steel & Vanadium Corp. Ltd's Mapochs Mine for the Highveld steel plant. Additionally, research was carried out during the year to recover titanium dioxide from the massive slag heap at Highveld Steel & Vanadium. The slag heap contained a 30% titanium dioxide content, current technologies, however, are incapable of recovering the material economically (Mining Journal, 1999).

Namakwa Sands Limited operated a heavy minerals sand mine at Brand-se-Baai and a mineral separation plant at Koekenapp, located 340 km northwest of Cape Town, and a smelter at Vredenburg, near the export harbor at Saldanha Bay. The project is being developed in two phases by the owners, Anglo American (80%) and De Beers Consolidated Diamond Mines Ltd. (De Beers) (20%); the state-owned Industrial Development Corp. provided a R370 million ($80 million) loan. In late 1994, the $260 million first phase started up, treating 4 Mt/yr of ore. The approximately 400,000 t/yr of heavy medium concentrates produced during Phase I had an average composition of 55% ilmenite, 15% zircon, 4% rutile, 16% other heavy minerals and 10% quartz. The smelter, using Mintek-developed plasma-arc technology, produced titanium slag and a coproduct pig iron from ilmenite concentrates. Planned Phase I production rates were 97,000 t/yr titania slag, 36,000 t/yr rutile, 123,000 t/yr zircon, and 56,000 t/yr pig iron. Actual production, however, was lower owing to lost time resulting from an explosion in the main furnace. The $220 million Phase II expansion began in 1997 and was expected to be completed by 2001. Mining and ore treatment will expand to 12 Mt/yr. A second direct-current plasma-arc furnace, scheduled for startup in March 1999, will double slag output. Production at full capacity will be 230,000 t/yr of high titanium slag, 42,000 t/yr rutile, 140,000 t/yr zircon, and 120,000 t/yr pig iron, generating an expected total export revenue of more than 1 billion annually.

In 1997, South Africa ranked second worldwide in the production and export of zirconium minerals. Zirconium was produced as a zircon byproduct of mining at the Richards Bay and the Namakwa Sands mineral sands operations. Palabora produced 70% of the world's baddeleyite, which is a zirconium sulfate mineral used in specialized applications in the refractory, ceramics, and tanning industries and in kidney dialysis machines. Sales of all zirconium products at Palabora fell to 10,799 t compared with 13,611 in 1996 principally owing to lower ore grades and plant operating difficulties in the first half of the year. Palabora invested an estimated $13 million during the year in a new plant that will produce zirconium basic sulfate (ZBS) from zircon sands. Equipment failures and mechanical problems delayed the commissioning of the ZBS plant until 1998. Full production capacity was expected to be 7,895 t/yr of product containing 38% ZrO_2 by 1999 (Palabora Mining Company Limited, 1998).

Uranium.—In 1997, uranium oxide production decreased to 1,324 t from the 1,706 t of that of 1996. The decrease in production was mostly attributable to the closure of Vaal Reef's No. 9 plant and the cessation of uranium production at Western Areas. Three South African gold mines produced uranium—Hartebeesfontein, Vaal Reefs, and Western Areas. More than 90% of uranium oxide production was as a byproduct of gold mining, and the remainder was produced as a byproduct of copper mining at Palabora. Additionally, the Atomic Energy Corp. began its commercialization program in response to declining funding from the Government (Harding, 1998).

Vanadium.—South Africa was the world's largest producer and exporter of vanadium in 1997. Vanadium was produced from titaniferous magnetite mined from the Bushveld Complex. Domestic output and sales value increased significantly, owing to strong world crude steel production and a concomitant rise in the market price for vanadium. The total domestic sales value of vanadium was about $190 million. The largest producer was Highveld Steel and Vanadium. Highveld's main products were vanadium slag and vanadium pentoxide flake, although modest amounts of vanadium trioxide also were produced, as was a small amount of ferrovanadium.

Rhombus Exploration (Rhoex) was the other major South African producer of vanadium (Mining Journal, 1997; Bates, 1998b). At yearend, the Swiss firm, Südelektra Holdings AG, consolidated its increasing control of the South African ferroalloys industry by purchasing from its parent company, Glencore International AG, Glencore's 87.1% stake in Rhoex and 100% interest in Vanadium Technology (Pty) Ltd. (Vantech) for about $152 million. Glencore International AG, a Swiss metal trading company, which had acquired its South African holdings in July 1997, agreed to purchase all the Rhoex and the Vantech output of vanadium pentoxide and ferrovanadium for the next 3 years as part of the deal. The combined vanadium production capacity of Rhoex and Vantech is around 10,000 t/yr, compared with Highveld's vanadium production level of around 28,000 t/yr. Südelektra was also offering to buy out the remaining minority shares of Chromecorp Holdings it did not already own. (Ingrid Salgado, December 17, 1997, Stakes in SA vanadium firms sold for R700 million, Business Day Online [Johannesburg], accessed January 12, 1998, at URL http://www.bday.co.za/97/1217/news/news4.htm).

Industrial Minerals

During the year, South Africa produced about 33 different industrial minerals from approximately 467 mines and quarries. The industrial minerals sector was a significant contributor to South Africa's total minerals sales, which approached 6% in 1997. The value of total sales of industrial minerals produced was about $803 million. Approximately 68% of those sales was on the domestic market. In terms of sales, the three dominant industrial

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mineral commodities were aggregate and sand, limestone and dolomite, and phosphate rock. The largest domestic consumers of South Africa's industrial minerals were the building and construction, metallurgical, and agricultural sectors. Total export earnings for industrial minerals were more than $260 million in. Commodities that contributed more than 90% of total industrial mineral export value were granite at 44.1%; phosphate rock, value withheld owing to proprietary reasons; andalusite, 10.8%; vermiculite, 8.3%; fluorspar, 7.8%; and asbestos, 5.7% (Botha and others, 1998).

Cement.—The dissolution of the cement cartel—the South African Cement Producers Association (SACPA)—in 1996, has increased competition, marketing has become more aggressive, product quality has improved, and product variety has increased among current operators. As of yearend 1997, cement in South Africa was produced by three main companies—Pretoria Portland Cement Co. Ltd., Alpha Ltd., and Lafarge South Africa Ltd. The three companies had equal interest in Natal Portland Cement Co. (Pty.) Ltd., which served much of the Natal market. South Africa was the third largest cement consumer in Africa, following Egypt and Algeria, and accounted for about 14% of all cement consumed in Africa. Cement demand was driven predominantly by the building sector, whose performance was mixed during the year. Government initiatives aimed at helping provide low-cost and affordable housing may stimulate the cement industry. South African cement imports were minimal, and accurate cement export figures are difficult to obtain owing to the disbanding of SACPA (Tradeship Publications, 1998).

Diamond.—According to the Minerals Bureau, South Africa's rough diamond production increased marginally in 1997 to an estimated 10 million carats (Mkt) from 9.9 Mkt in 1996. As in years past, mines owned by De Beers dominated the sector with more than 95% of the total production. Total diamond production for De Beers' South African operations in 1997 amounted to 9.56 Mkt recovered from 21.9 Mt of material treated. The Venetia Mine, the largest De Beers operation accounted for 45.3% of production; the Finsch Mine, 23.3%; the Premier Mine, 15.2%; the Namaqualand Mine, 8.3%; the Kimberley Mine, 6.4% and the Koffiefontein Mine, 1.4%. Diamond recovery rates varied considerably within the De Beers operations, with Venetia recovering 127 carats per ton (kt/t), Finsch, 59.5 kt/t, Premier, 45.3 kt/t, the Kimberley Mine, 16.1 kt/t, the Namaqualand Mine, 13.8 kt/t, and the Koffiefontein Mine, 6.6 kt/t. (De Beers, 1997).

Of the 65 officially permitted diamond mines in South Africa, 48 produced diamonds during the year. Of these, 19 recovered diamonds from marine environments, 16 mined kimberlites, and 13 mined alluvial deposits. Kimberlite operations produced 8.94 Mkt, much of it attributable to increased production from the Finsch and the Venetia Mines. Alluvial diamond operations contributed 1.04 Mkt, and marine diamond recovery totaled 60,041 carats. Additional diamond production came from approximately 400 artisanal operations mining alluvial deposits in the Free State, the North-West and Northern Cape Provinces. In 1997, South African rough diamond export sales mass and the value of rough diamonds available for the domestic cutting and polishing industry increased (Damarupurshad, 1998b).

Vermiculite.—Production of exfoliated vermiculite remained around 211,000 t in 1997, representing about 75% of reported world supply. The major producer was the Vermiculite Operations Division of Palabora, which extracted vermiculite from the pyroxenite units of the mineralogically diverse Phalaborwa Carbonatite Complex. The company reported vermiculite concentrate production of 207,070 t grading 90.74% vermiculite. Vermiculite production at the Natkruit Vermiculite Mining Co. mine and beneficiation plant in the Northern Province was expected to startup in March 1998 at a rate of 22,000 t/yr of unexfoliated vermiculite (Palabora Mining Company Limited, 1998).

Mineral Fuels

Most of South Africa's primary energy needs were supplied by coal; most electricity was generated by coal-fired power stations; and coal was also the raw material for South Africa's production of synthetic fuels. South Africa's synfuels program has been in place for many years. Soekor controlled all offshore oil and gas prospects. During the year, Soekor began crude oil production from the Oribi Field, South Africa's first offshore oilfield. Soekor estimated that the Oribi Field, 140 km southwest of Mossel Bay, had reserves of 20 million barrels of crude oil and had targeted a production of 20,000 barrels per day (bbl/d) from two wells (Knott, 1997; Prevost, 1998a). South Africa's total throughput refining capacity for crude oil was 465,000 bbl/d from four refineries. Owing to the high cost of synfuels compared with conventional crude oil products, the Government emplaced various tariffs and controls on the petroleum marketing sector. Industry observers generally agreed that the South African energy industry and tariff system was in need of restructuring and/or privatization (Knott, 1997).

South Africa remained the fifth largest coal-producing country in the world and the third largest coal exporter. Coal exports for 1997 were 59 Mt valued at $1.7 billion and were shipped primarily through the Richards Bay Coal Terminal (RBCT). Export destinations for South African coal were Europe (54.1%), Asia and the Middle East (38%), Africa (4.2%), and South America (3.6%). Coal produced for domestic use totaled 157 Mt valued at $1.6 billion (Prevost, 1998b). Three companies, Ingwe Coal Corp., Anglo American Coal Corp. Ltd. (Amcoal), and Sasol Mining (Pty.) Ltd., continued to account for more than 80% of the country's coal production. Ingwe had been formed through the merger of Trans-Natal Coal Corp. Ltd. and Randcoal in 1994. Other producers included Iscor, which mined coal for its own internal use. In addition, numerous medium-to-small, independent coal companies mined coal. Approximately 45% of all coal mined in South Africa was through open-cast methods (Prevost, 1998b).

Reserves

South Africa's mineral reserves are large and varied and reflect the country's complex geology. A detailed account of the geology of many of South Africa's mineral deposits is available from the

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Geological Society of South Africa and a useful background geologic summary is given in Mining Magazine (Anhaeusser and Maske, 1986; Mining Magazine, 1995). The bulk of South Africa's mineral production is from the northern half of the country. Table 2 lists the reserve base for a number of South Africa's major minerals; diamond reserve data are unavailable. Although data for many of the minerals shown are incomplete for the world, South Africa's reserves appear to rank among the top five countries and would rank first in the world for andalusite, chromite, gold, manganese, PGM, and vanadium.

Infrastructure

The country has a well-developed and extensive road and railroad infrastructure, serving not only South Africa but also the surrounding region. Roadways totaled 182,329 km, of which 55,428 km were paved. Railroad infrastructure totaled 21,431 km, of which 9,087 km was electrified. A number of ports handled minerals, notably Cape Town, Durban, East London, Mossel Bay, Port Elizabeth, Richards Bay, and Saldanha Bay. In addition to fulfilling the requirements of South Africa itself, the country's ports also served as outlets for such landlocked countries as Botswana, Lesotho, Swaziland, Zambia, and Zimbabwe. South Africa was also a regional supplier of electricity and petroleum products, two of a number of examples of the dependence of neighboring countries on South Africa's infrastructure and transportation networks.

Richards Bay handled more than half the volume of cargo among South African ports. The Richards Bay Coal Terminal (RBCT) had a coal export capacity of about 60 Mt/yr out of a total bulk cargo port capacity of 75 Mt/yr. Coal exports through Durban and the Mozambican port of Maputo were only a fraction of those through the RBCT. Durban's port facilities were designed mainly for small consignments of high-quality lump bituminous coal and anthracite that cannot be properly handled at Richards Bay.

South Africa's national electical power utility, Eskom, had a nominal capacity of 39,154 megawatts, predominantly from coal-fired sources, with a small percentage of electricity being generated from nuclear sources (Eskom, 1999, Key statistics, Annual Report for 1998, accessed March 30, 1999, on the World Wide Web at URL http://www.eskom.co.za/annreport/main.htm).

Outlook

Significant labor issues within the minerals sector, such as housing of migrant workers, wages, job training, and work schedules, will likely continue for the next several years. The high incidence of HIV/AIDS in South Africa also poses a threat to the workforce and economic development. Additionally, the ongoing corporate restructuring in South Africa and concomitant mine closures could further stimulate job losses in the mining industry, particularly the gold sector. Wildcat strikes and other labor disturbances were ongoing in 1997 and could be recapitulated in 1998.

Increased attention was expected to be given to environmental issues, which also would be factors in projects requiring financing from international lending institutions. The major mining companies will likely continue to increase their holdings and activities overseas, including the forming of strategic alliances with major overseas customers. The extent to which this will contribute to new investment in South African mining is uncertain, although the large and high-quality resource base should remain attractive to new foreign investors, provided that the political risk climate remains stable.

South Africa's mining industry is highly dependent on export revenues—more than 78% of total sales in 1997 were to various world markets. The South African Minerals Bureau predicts a rise in revenue into the next century from exports of base metals, coal, industrial minerals, ferrous minerals, PGM, and processed mineral products. The notable exception in the forecast is gold. The Minerals Bureau, however, asserts that the forecast is dependent on the short duration for the Asian financial turmoil and the continued strength in the economies of western European countries which are traditional markets for South African minerals (Gcabashe and others, 1998).

South Africa appeared to be entering a phase of rapid expansion of value-added mineral processing capacity, especially for metals. For example, in steel, its ready domestic access to nearly all the steelmaking raw materials give it a potentially, natural competitive advantage, offset partially by its long distances to world markets. In this regard, if labor and energy costs remained low and world markets remained buoyant, then South Africa had the potential to greatly increase its market share for many commodities.

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Fax: (27) 12 841-1203 or 1221
Internet site: http://www.geoscience.org.za

Department of Mineral and Energy Affairs
Government Mining Engineer
Private Bag X59
0001 Pretoria, South Africa
Telephone: (27) 12 322-8561
Fax: (27) 12 322-3416
Internet site: http://www.dme.gov.za

Minerals Bureau
Private Bag X4
2017 Braamfontein, South Africa
Telephone: (27) 11 339-4414
Fax: (27) 11 403-2061
Internet site: http://www.dme.gov.za/minerals/default.htm

Department of Trade and Industry
Private Bag X274
0001 Pretoria, South Africa
Telephone: (27) 12 3322-7677
Fax: (27) 12 322-7851
Internet site: http://wwwdti.pwv.gov.za/dtiwww/Home.htm

Embassy of South Africa
Minerals and Energy Liaison Office
3051 Massachusetts Ave., NW
Washington, DC 20008
Telephone: (202) 232-4400
Fax: (202) 232-3402

Industrial Development Corp. of South Africa Ltd.
P.O. Box 784055
2146 Sandton, South Africa
Telephone: (27) 11 883-1600
Fax: (27) 11 883-1655

Minerals and Energy Policy Centre
76 Juta St., 9th Floor
2050 Braamfontein, South Africa
Telephone: (27)-11-403-8013
Fax: (27)-11-403-8023

Mintek (Council for Mineral Technology)
Private Bag X3015
2125 Randburg, South Africa
Telephone: (27) 11 709-4111
Fax: (27) 11 793-2413 or 709-4326
Internet site: http://www.mintek.ac.za

National Union of Mineworkers
P.O. Box 2424
2000 Johannesburg, South Africa
Telephone: (27)-11-833-7012
Fax: (27)-11-836-0201
Internet: http://www.anc.org.za/num

Major Publications

Chamber of Mines of South Africa: Annual Report.
Statistical Tables 1996, and 1997.
Department of Mineral and Energy Affairs: Annual Report.
Minerals Bureau:
South Africa's Mineral Industry 1997/98.
Operating mines and quarries and mineral processing plants in the Republic of South Africa: various periodic directories.
Mineral Production and Sales Statistics, monthly.

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TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
METALS						
Aluminum metal, primary		174,700	172,111	195,292	569,600 r/	673,043
Antimony concentrate: 2/						
Gross weight e/		7,182 3/	7,800	9,550	8,860	5,390
Sb content		4,111	4,534	5,537	5,137	3,415 e/
Cadmium, Cd content of cadmium cake		70 e/	--	--	--	--
Chromite, gross weight:						
More than 48% chromic oxide	thousand tons	4	--	16	--	--
44% to 48% chromic oxide	do.	1,808	1,612	1,792	1,862	2,123
Less than 44% chromic oxide	do.	1,014	2,030	3,296	3,155	3,617
Total 4/	do.	2,827	3,642	5,104	5,017	5,740
Cobalt:						
Mine output, Co content		265	358	288	350	450
Refinery output:		243	258	190	244 r/	317
Copper:						
Mine (company output), Cu content		166,348	165,213	165,573	152,595	153,058
Metal:						
Smelter		156,600	154,700	151,200	148,400 r/	163,600
Refined, primary		127,900	129,600	124,300	116,000	130,200
Gold, primary	kilograms	619,201	580,201	523,809	496,846 r/	491,680
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	29,385	30,489	31,946	30,830	33,225
Fe content	do.	19,100 e/	18,903	19,806	19,115	20,600 e/
Metal:						
Pig iron	do.	6,121	6,982 r/	7,137 r/	6,876 r/	6,192
Direct-reduced iron	do.	833	980	950	900 r/	1,090 e/
Ferroalloys, electric arc furnace:						
Chromium ferroalloys	do.	834	1,104	1,341	1,478 r/	1,890
Ferromanganese	do.	393	591	480	562 r/	499
Ferrosilicon	do.	99	120	90	118 r/	102
Ferrovanadium e/	do.	1	1	1	1	1
Silicomanganese e/	do.	268 3/	290 3/	280	241	286
Silicon metal	do.	38	36	30	29 r/	34
Crude steel	do.	8,726	8,525 r/	8,741 r/	7,999 r/	8,311
Lead:						
Concentrate, Pb content		100,171	95,824	88,449	88,613	83,114
Smelter, secondary		31,800	31,900	32,100	32,200 r/	41,500
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% manganese	thousand tons	1,239	1,533	1,708	1,845	1,809
45% to 48% manganese	do.	237	67	106	86	84
40% to 45% manganese	do.	299	196	191	118	116
30% to 40% manganese	do.	665	1,006	1,145	1,133	1,111
Total, metallurgical 4/	do.	2,440	2,801	3,151	3,182	3,120
Chemical, 35% to 65% manganese dioxide	do.	67	50	48	58	33
Grand total	do.	2,507	2,851	3,199	3,240	3,153
Metal, electrolytic e/	do.	35	35	35	39 r/	40
Nickel:						
Mine output, concentrate, nickel content e/		30,800	31,800	30,700	33,861 r/ 3/	34,830 3/
Metal, electrolytic		29,868	30,751	29,803	33,362	33,700
Platinum-group metals: e/						
Platinum	kilograms	104,506	98,285	102,300	105,440	115,080
Palladium	do.	43,389	46,655	51,000	52,560	56,300
Rhodium	do.	8,647	10,264	10,900	11,200	11,500
Other 5/	do.	19,625	28,722	18,897	19,436	13,586
Total	do.	176,167 3/	183,926 3/	183,097 r/ 3/	188,636 r/ 3/	196,466 3/
Silver	do.	192,418	197,767	174,279	168,689 r/	144,004
Thorium, monazite concentrate, gross weight e/		400	131 3/	--	--	--

See footnotes at end of table.

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TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
METALS--Continued						
Tin:						
Cassiterite concentrate:						
Gross weight e/		1,200	--	--	--	--
Sn content		452	--	--	--	--
Metal:						
Primary 6/		452	43	--	--	--
Secondary e/		50	50	--	--	--
Titanium: e/						
Ilmenite concentrate	thousand tons	1,516	1,314	1,680	2,100	2,237
Rutile concentrate	do.	86	78	90	115 r/	123
Total, titanium minerals	do.	1,602	1,392	1,770	2,215	2,360 3/
Titaniferous slag 7/	do.	937	819	990	1,000 e/	1,100 e/
Uranium oxide		2,008	2,069	1,702	1,706	1,324
Vanadium, vanadium metal content		15,051	16,350 r/	16,297 r/	14,770 r/	15,590
Zinc:						
Concentrate:						
Gross weight e/		140,000	140,000	130,000	142,000	132,000
Zn content		77,096	76,361	70,241	76,853	71,062
Metal, smelter, primary		96,154	93,850	98,782	101,100	108,100
Zirconium concentrate (baddeleyite and zircon) e/		243,000	240,000	260,000	260,000	265,000 3/
INDUSTRIAL MINERALS						
Aluminosilicates:						
Andalusite		187,708	206,291	206,378	233,728 r/	251,203
Sillimanite		569	525	317	-- r/	--
Asbestos:						
Chrysotile		92,380	85,857	81,246	51,776	49,754
Crocidolite		11,614	6,273	7,396	5,344	232
Total		103,994	92,130	88,642	57,120	49,986
Barite		2,000	1,945	6,048	7,428	2,071
Calcite		14,094	14,660	10,666	13,749 r/	2,886
Cement, hydraulic	thousand tons	7,356	7,905	9,071	7,668	7,490
Clays:						
Attapulgite		7,032	10,230	8,049	14,318	9,349
Bentonite		50,441	71,773	70,927	48,076	33,326
Fire clay		91,839	110,131	74,751	101,452	131,307
Flint clay, raw and calcined		89,352	131,590	118,688	113,645	92,397
Kaolin		147,349	131,863	146,587	146,496	120,148
Brick clay, local sales	thousand tons	1,028	1,386	2,909	3,013	3,227
Diamond, natural:						
Gem e/	thousand carats	4,600	4,900	4,300	4,400	4,500
Industrial	do.	5,724	5,954	5,383	5,546	5,541
Total 4/	do.	10,324	10,854	9,683	9,947 r/	10,041
Feldspar		56,761	37,156	47,874	53,644 r/	59,688
Fluorspar:						
Acid-grade		194,778	166,761	177,000	202,018 r/	201,000
Ceramic-grade e/		3,800	--	--	--	4,000
Metallurgical-grade e/		19,000	7,497 3/	18,794 3/	10,000 r/	2,000
Total		217,578	174,258	195,794	202,018 r/	207,000
Gemstones, semiprecious:						
Rose quartz	kilograms	85,500	--	--	--	--
Tiger's eye	do.	548,386	531,418	242,607 r/	18,650 r/	64,300
Gypsum, crude		284,389	304,337	288,178	340,688	365,279
Industrial or glass sand (silica)	thousand tons	1,738	1,920	2,180	2,168 r/	2,439
Lime 6/	do.	1,599	2,891	1,688	1,650	1,585
Magnesite, crude		67,403	71,726	84,639	71,358	76,699
Mica, scrap and ground		1,991	1,973	2,137	1,515	1,423
Nitrogen, N content of ammonia		683,400	754,000	758,500	769,800	770,000
Perlite		328	914	1,338	1,300	403
Phosphate rock:						
Gross weight	thousand tons	2,466	2,545	2,787	3,077	2,732
Phosphorus pentoxide content e/	do.	962	995	1,087	1,200	1,038

See footnotes at end of table.

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TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
INDUSTRIAL MINERALS--Continued						
Pigments, mineral, natural:						
Ochers		1,175	1,789	2,316	484	186
Oxides		11	295	2,940	159	98
Total		1,186	2,084	5,256	643	284
Salt		613,301	414,463	311,388	253,403	320,000
Sodium sulfate, natural		36,380	44,544	43,971	46,947	49,071
Stone, n.e.s.:						
Dimension:						
Granite and norite 6/		528,310	618,781	812,220	635,005	764,000
Marble 8/		20,615	12,450	5,837	689	1,700
Slate 6/		22,019	15,501	11,891	11,940	11,900
Crushed and broken:						
Limestone and dolomite	thousand tons	18,215	19,548	19,738	22,038	22,214
Nepheline syenite		--	98,667	145,459	137,706 r/	114,201
Quartzite 6/	thousand tons	8,224	9,258	9,123	8,515	8,500
Shale:						
For cement	do.	331	371	325	383	47
Other 6/	do.	2,767	2,157	3,248	3,000 e/	3,000 e/
Total	do.	3,098	2,528	3,573	3,383	3,047
Aggregate and sand, n.e.s.	do.	15,824	18,294	20,594	20,792	31,692
Sulfur:						
S content of pyrite	do.	323	252	159	184	167
Byproduct:						
Metallurgy e/	do.	82	118	117	91	110
Petroleum	do.	171	209	233	200	293
Total 4/	do.	575	579	509	475	470 e/
Talc and related materials:						
Talc		8,798	8,202	9,173	16,397	21,055
Pyrophyllite (wonderstone)		4,287	5,507	5,519	2,140	2,129
Vermiculite		211,143	223,478	221,748	186,082	211,001
MINERAL FUELS AND RELATED MATERIALS						
Coal (salable product):						
Anthracite	thousand tons	3,246	2,225	2,137	2,465 r/	1,997
Bituminous	do.	178,980	193,625	204,073	203,803 r/	216,453
Total 4/	do.	182,226	195,850	206,210	206,269 r/	218,450
Petroleum:						
Crude	thousand 42-gallon barrels	--	--	--	--	4,380
Refinery products:						
Liquefied petroleum gases	do.	2,460	1,825	3,285	3,300 e/	3,300 e/
Gasoline	do.	57,446	59,860	73,730	74,000 e/	74,000 e/
Jet fuel	do.	6,346	7,665	8,760	9,000 e/	9,000 e/
Kerosene	do.	4,678	5,475	7,300	7,300 e/	7,300 e/
Distillate fuel oil	do.	31,136	35,770	50,005	50,000 e/	50,000 e/
Residual fuel oil e/	do.	16,000	20,075 3/	22,995 3/	23,000	23,000
Lubricants (including greases) e/	do.	2,503 3/	1,280 3/	3,000	3,000	3,000
Bitumen e/	do.	1,784 3/	895 3/	2,000	2,000	2,000
Other e/ 9/	do.	700	380 3/	4,855	4,900	4,900
Total 10/	do.	123,053	133,225	175,930	176,500 e/	176,500 e/

e/ Estimated. r/ Revised.

1/ Table includes data available through July 19, 1999.

2/ Data are for the year ending June 30 of that stated.

3/ Reported figure.

4/ Data may not add to totals shown because of independent rounding.

5/ Difference between total production reported by Minerals Bureau and Pt, Pd, and Rh supplies (shipments) reported in Johnson and Matthey Annual Platinum Review. Includes ruthenium and iridium production plus excess Pt, Pd, or Rh inventory.

6/ Domestic sales plus exports.

7/ Except for about 45,000 metric tons per year slag derived from titaniferous magnetite by Highveld Steel, titaniferous slag is all from the smelting of ilmenite and likely represents most of that mineral's production, for which data are unavailable.

8/ Converted from reported cubic meters using 1 cubic meter = 2.7 tons.

9/ Includes naphthas, paraffin wax, petroleum coke, petrochemical feedstocks, unfinished oils, white spirits, and blending compounds.

10/ Excludes refinery fuel and losses.

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TABLE 2
SOUTH AFRICA: RESERVE BASE OF MAJOR MINERALS IN 1997 1/

(Million metric tons unless otherwise specified)

Commodity		Reserve base
Andalusite 2/		51
Antimony	thousand tons	250
Asbestos, fiber		8.2
Chromium, ore		3,100
Coal, recoverable		55,300
Cobalt	thousand tons	15
Copper		13
Fluorspar		36
Gold	thousand tons	40
Iron ore		5,900
Lead		3
Manganese		4,000
Nickel		11.8
Phosphate rock, concentrates		2,500
Platinum-group metals	thousand tons	62.8
Silver	do.	10
Titanium		72
Uranium 3/	thousand tons	204.7
Vanadium		12.5
Vermiculite		80
Zinc		15
Zirconium		14.3

1/ Metallic minerals are contained metal.
2/ Includes the aluminosilicate, sillimanite.
3/ Recoverable at a cost of less than $80 per kilogram.

Source: Chamber of Mines Online Statistical Tables 1997, accessible at URL http://www.bullion.org.za/panl/genrl/sawmres.htm. Minerals Bureau estimates as of December 31, 1997.

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THE MINERAL INDUSTRY OF

SUDAN

By Philip M. Mobbs

Mineral commodities produced in Africa's largest country included cement, chromite, crude construction material, gold, gypsum, limestone, crude oil, petroleum refinery products, and salt. (*See table 1.*) The quantities were relatively small, and the industry contributed very little to Sudan's economy. The 14-year-old civil war in the south adversely affected mineral exploration in the region. The political climate and continued economic instability were likely to deter major international efforts at further exploiting the remaining mineral potential of Sudan for some time. For more extensive coverage of the mineral industry of the Sudan, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

TABLE 1
SUDAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Cement, hydraulic		250,000	250,000	391,000	380,000	380,000
Chromite, mine output, gross weight 3/		11,500	25,000	44,988 r/	15,000	10,000
Gold, mine output, Au content	kilograms	1,600	3,000	3,700	4,500	5,000
Petroleum:						
Crude (including lease condensate)	thousand 42-gallon barrels	360	730	730	1,000	6,000
Refinery products	do.	6,200	6,500	6,600	7,000	7,000
Salt		75,000	75,000	75,000	50,000	50,000

r/ Revised.

1/ Includes data available through August 14, 1998.

2/ In addition to the commodities listed, the following are presumably produced but available information is inadequate to reliably estimate output: clay and/or shale for cement manufacture (normally about 0.4 ton clay and/or shale per ton of finished cement); gypsum for cement manufacture (about 0.04 ton per ton of finished cement) and plaster; limestone for cement manufacture (normally at least 1.25 ton per ton of finished cement), agriculture, lime manufacture, and construction aggregate and fill; and other locally used construction materials (clays, sand and gravel, stone, et al.).

3/ Presumed to be ores and concentrates with an estimated average grade of about 48% chromic oxide.

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THE MINERAL INDUSTRY OF

SWAZILAND

By George J. Coakley

Mining was a small but important factor in Swaziland's economy, accounting for about 2% of the gross domestic product and generating about $20.5 million in sales revenues in 1997.[1] Mining activities employed fewer than 1,000 workers; an additional 10,000 to 15,000 Swazis, however, were employed in South African mines, which contributed to the country's economy by wage repatriation.

Mineral production was limited to three commodities—asbestos from the Bulembu Mine, anthracite coal from the Maloma Mine, and crushed stone from two aggregate quarries at Kwalini and Tonkwane. (*See table 1.*) Diamond production had ceased at the end of 1996 with the closure of Trans Hex Limited's Dvokolwako Mine. Rights to the remainder of the Dvokolwako diamond deposit reverted to the joint-venture partner, the Swaziland National Trust Organization, Tibiyu Taka Ngwane. Some exploration for gold was underway in 1997, but declining gold prices were a disincentive. For more extensive coverage of the minerals industry of Swaziland, see the 1996 Minerals Yearbook, Volume III, Mineral Industries of Africa and the Middle East.

[1]Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate of E4.61=US$1.00 for 1997.

Major Sources of Information

Ministry of Natural Resources and Energy
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Mbabane, Swaziland
Telephone: 268-46-244
Fax: 268-42-436
Geological Survey and Mines Department
P.O. Box 9
Mbabane, Swaziland
Fax: 268-45215

TABLE 1
SWAZILAND: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity 2/		1993	1994	1995	1996 r/	1997
Asbestos, chrysotile fiber	metric tons	33,900	26,720	28,570	26,014	25,888
Coal, anthracite	thousand metric tons	50	228	172	129	203
Diamond	carats	61,700	76,100	75,000	75,000	--
Stone, quarry products	thousand cubic meters	163	185	114	221	456

r/ Revised.
1/ Includes data available through June 23, 1999.
2/ In addition to the commodities listed, modest quantities of crude construction materials (brick clay, sand and gravel) and pyrophyllite are produced, but output is not reported quantitatively, and information is inadequate to make reliable estimates of output levels.

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THE MINERAL INDUSTRY OF

TANZANIA

By George J. Coakley

The United Republic of Tanzania, including the semi-independent islands of Zanzibar, is located between Kenya and Mozambique on the east coast of Africa and has a land area of 886,040 square kilometers. The area supported a population of 29.7 million in 1997 with a gross domestic product (GDP) per capita of $1,350. The mining and petroleum sectors, which played a relatively small role in the chiefly agrarian economy of Tanzania, accounted for less than 3% of the total nonsubsistence workforce of 168,600 and for about 5% of the GDP. In 1997, the value of mineral exports, primarily diamond ($14.82 million), semiprecious gemstones ($7.95 million), and gold ($2 million), declined by 13%, to $25.7 million, down from $29.58 million in 1996. Encouraged by more aggressive Government investment policies and the exploration successes reported in 1996 and 1997, however, mining is on the verge of becoming a significant part of the Tanzanian economy. Although the country's natural resources include coal, cobalt, diamond, gemstones, graphite, iron ore, natural gas, nickel, and phosphate rock, gold will be the dominant mineral commodity in the foreseeable future.

Exploration results through the end of 1997, as reported by seven of the most active operators, has identified approximately 300 metric tons (t) (9.6 million troy ounces) of drill measured and indicated gold resources and an additional 252 t (8.1 million troy ounces) of inferred gold resources. Given the depressed level of gold prices, companies have been cautious about moving exploration results from the resource to the reserve category until full bankable feasibility studies are completed. The majority of discoveries to date are focused on near surface deposits grading from 2 to 5 grams per ton (g/t). One high-grade deeper deposit has been reported at Bulyanhulu with grades ranging from 12 to 14 g/t. The Government remains optimistic that several of these projects will be brought into production over the next 5 years.

Administration of the mining sector is the responsibility of the Ministry of Water, Energy and Minerals under the Mining Act of 1979. Investment in the petroleum sector was governed by the provisions of the 1980 Petroleum (Exploration and Production) Act. The Mining Law of 1979 has been modified by the Policy Issue Papers of 1983, which proposed the mineral wealth of Tanzania to be the nation's heritage and gave the state majority ownership in mining activities. The Model Agreement of 1988, however, removed the Government majority ownership requirement. The Government was reviewing the Mining Act and a new act was expected to be enacted by the Parliament in 1998. In August 1997, the National Investment (Promotion and Protection) Act of 1990 was repealed, and a new Tanzania Investment Act was enacted, creating the Tanzania Investment Centre, a one-stop-center that would promote, coordinate, and facilitate investment. Investments are now guaranteed against nationalization and expropriation. The Tanzania Investment Act sets corporate tax rate for the mining sector at 30% and provides additional customs rates, capital allowance deductions, depreciation, and other tax incentives (Tanzania Investment Centre, 1997). Mining royalties are set at 3% of netback value, with a rate of 5% for diamond. No royalties are paid on cut and polished gemstones. The new Financial Laws (Miscellaneous Amendments) Act of 1997 also provided improved fiscal incentives for the mining sector. In October 1997, the Ministry of Water, Energy and Minerals issued a new minerals policy, giving priorities to private sector initiatives, the rationalization and organization of artisinal and small-scale mining and product marketing, and new initiatives to mitigate the adverse environmental and social aspects of mining. The Ministry's vision statement includes increasing the contribution of mining to the economy to more than 10% of the GDP and establishing a value-added gemstone-cutting and jewelry-manufacturing industry. It promotes the role of the Government as a regulator, promoter, facilitator, and service provider to the private sector and not as a direct player in production activities.

The country has been successful in attracting mineral exploration and investment and has triggered a "gold rush" in the greenstone belts at the southern end of Lake Victoria. Exploration companies from Australia, Canada, South Africa, Sweden, and the United Kingdom have been very active in Tanzania, with annual exploration expenditures increasing to about $80 million in 1997 from $6 million in 1992. During the 1997-98 fiscal year, 516 applications for exploration and mining licenses were received, of which 462 were approved, including 335 for gold. Other licenses covered base metals, gemstones, helium, nickel, soda ash, and uranium.

The 1979 Mining Act required that prospectors provide environmental statements with applications for permits before a license was issued. The National Environment Management Act of 1983 covered environmental matters and authorized a National Environmental Council to regulate environmental activities. Mining is not permitted in national parks or in the Ngorongoro Conservation Area, but is allowed by special permits in game reserves. The 1997 minerals policy document further strengthens the Government's commitment to the environmental and social sustainability of mining development and sets the stage for additional environmental regulatory and management programs.

Historically, diamonds and gold have been the most important minerals produced in Tanzania, with mining of semiprecious gemstones increasing in importance in recent years. Tanzania also produces construction materials, including cement and other industrial minerals. Fuel mineral production in Tanzania has been limited to steam coal from the mine at Kawire and a small amount of petroleum refinery products. Mineral production statistics for the period from 1993 to 1997 are noted in Table 1.

During the year, gold exploration and development planning dominated the industry news, with several companies announcing or expanding on the discovery of significant gold resources.

In November 1997, construction began on the $47 million

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Golden Pride gold mine held equally by Resolute Ltd. of Australia (Resolute Tanzania Ltd.) and Samax Resources Ltd. of the United Kingdom (Samax Mabungu Ltd.). It will be the first of the new gold deposits to be developed. The Golden Pride resource base was updated in October 1997 to 33.41 million metric tons (Mt) of ore, grading 2.56 g/t of gold and containing 85,530 kilograms (kg) of gold, including an interim minable reserve totaling 12.43 Mt, grading 2.62 g/t and containing 32,380 kg of gold (Samax Resources Ltd., 1998). In response to lower gold prices, the open-pit design was optimized to yield an average ore grade of 3.2 g/t during the first 6 years by using three starter pits that will eventually be merged into one pit. The project design plans called for a conventional carbon-in-leach (CIL) plant to treat 2 million metric tons per year (Mt) of ore per year yielding about 5,600 kilograms per year (kg/yr) of gold over an 8 year mine life. The Golden Pride project is scheduled for startup in the last quarter of 1998.

Samax is also actively exploring its fully owned concessions at Geita-Kukuluma, south of Lake Victoria and adjacent to Ashanti Goldfields' proven Geita deposit. Preliminary drilling by Samax has identified two deposits, Kukuluma Hill, containing an indicated resource of 7.9 Mt tons grading 4.81 g/t of gold, and the "3 West" deposit, containing an inferred resource of 2.1 Mt of mineralization grading 4.8 g/t of gold. The combined resources have a total contained gold content of 47,870 kg (Samax Resources Ltd., 1998). The continuous and nearly vertical mineralized zones are preferentially developed in banded iron formation-chert units. During 1998, Samax will test additional nearby soil anomalies and prepare a $6 million feasibility study on bringing the Kukuluma deposit into production at a proposed rate of 3,730 kg/yr of gold by 2000.

The Bulyanhulu gold prospect of Sutton Resources Ltd. of Canada was the largest resource delineation reported in Tanzania to date. Calculations based on drilling to December 31, 1997, increased the total identified gold resource to 17.5 Mt, grading 13.14 g/t and containing 230 t of gold. The estimate for Bulyanhulu Reef 1 included 7.37 Mt of measured resource grading 13.87 g/t; 3.55 Mt of indicated resource, grading 12.16 g/t; and 5.92 Mt of inferred resource, grading 13.00 g/t. The inferred resource at the Bulyanhulu Reef 2 was reported to be 0.71 Mt, grading 11.63 g/t. The steeply dipping (80° NE), quartz-sulfide reefs occur in a graphitic shear zone. The hanging and footwall lithologies are felsic and intermediate volcanics, respectively. During 1997, Sutton spent $18.8 million primarily towards advancing underground development, infrastructure, feasibility studies, engineering, and exploration drilling. The company will make a production and financing decision on the project during 1998, following the completion of the full feasibility study in April. A draft feasibility study based on lower 1996 resource estimates indicated the potential for producing about 9,300 kg/yr of gold from Reef 1. Development costs, including the mine, infrastructure, and a 2,500-metric-ton-per-day treatment plant, were estimated to be $134 million (Sutton Resources Ltd., 1998a, 1998b).

Pangea Goldfields Inc. (Canada) holds about 35 gold exploration licenses in the greenstone belts south of Lake Victoria and has joint-venture agreements with the Anglo American Corp. of South Africa Ltd. to explore the Chocolate Reef and the Kahama prospects; with Ashanti Goldfields Co. Ltd. of Ghana to explore the Bulyanhulu South lease; with Minieres du Nord Ltd. (MDN) of Canada to explore the Kangele deposit; and with Randgold Resources of South Africa to explore the Golden Ridge deposit. The Golden Ridge project is the most advanced, with drilling by Randgold having defined a total indicated and inferred resource of 34 Mt grading 1.46 g/t and containing 49.6 t of gold, of which measured and indicated resources, treatable by CIL methods, were reported to be 11.61 Mt, grading 2.73 g/t and containing 31.7 t of gold. The bulk of the mineralization at Golden Ridge is located in banded ironstones in the Nyaligongo Main Zone in contact with a greywacke-tuff. Studies have confirmed the potential for an open-pit mining operation with the ore treatable by both heap leaching and conventional milling extraction techniques. Following the completion of the final feasibility study, a production decision is expected by mid-1998. Production rates ranging from 2,300 to 4,300 kg/yr were being examined. Randgold, the joint-venture manager, can increase its equity interest from 50% to 65% by completing the feasibility study and securing project financing by September 14, 2000 (Pangea Goldfields Inc., 1998).

Pangea reported an early 1997 indicated and inferred resource estimate at the Kahama/Chocolate Reef property of 13.26 Mt grading 2.87 g/t and containing 38 t of gold on the basis of a cutoff grade of 1 g/t gold. Anglo American, which holds a 70% interest in the joint venture, continued exploration drilling on the Chocolate Reef structure during the year and was expected to update the resource estimate and to complete a prefeasibility study in 1998 (Pangea Goldfields Inc., 1998).

Ashanti Goldfields' joint-venture agreements with Pangea allows Ashanti to earn a 60% to 75% interest in the Bulyanhulu South and the Robondo properties by spending $4 million and $3 million, respectively, completing feasibility studies, and securing development funding by October 2000. Ashanti will conduct further exploration drilling on both properties in 1998. MDN was increasing their interest in the Pangea's Kangele property from 20% to 50% by agreeing to spend $2 million by the end of 1999, including on further exploration of mineralized structures discovered in 1997. On the basis of the second phase of diamond drilling and a cutoff grade of 1 g/t, Pangea reported an inferred resource, of 1.83 Mt, grading 4.6 g/t at their wholly owned Mguzu property, west of Geita (Pangea Goldfields Inc., 1998).

In early 1996, Ashanti acquired an 85% interest in the old Geita gold mine and adjacent exploration property in the Lake Victory Gold Belt through the acquisition of Cluff Resources plc. of the United Kingdom. In 1997, Ashanti increased its ownership to 100%. Ashanti's $6 million exploration program in 1997 tripled open-pittable resource estimates at the Lone Cone-Geita Northeast Extension. The measured resource was reported to be 20 Mt, grading 2.9 g/t, equivalent to 59.1 t of gold; the indicated resource, 12 Mt, grading 2.7 g/t, and containing 31.1 t of gold; and the inferred resource 4 Mt, grading 3.6 g/t, equivalent to 15.6 t of gold. The total resource is more than 105 t of gold (3.4 million troy ounces). A prefeasibility study on the open-pit potential of Geita was completed in December 1997, and a bankable feasibility study was expected to be completed in 1998. Initial metallurgical tests confirmed the nonrefractory nature of the mineralization, with recoveries exceeding 90% for the oxides and averaging 85% for the transition and sulfide ores. Ashanti also announced the discovery of a new high grade mineralized zone at Nyankanga, west of Lone Cone (Ashanti Goldfields Company Ltd., 1998). If a decision is made to go ahead with the development of the Lone Cone-Geita property, then production would begin in early 2000 at rate ranging from 5,600 to 6,220 kg/yr for 10 years, although

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power availability remained a concern (Vincent t'Sas, Ashanti looks at new gold mine in Tanzania, April 16, 1998, accessed April 22, 1998, at URL http://biz.yahoo.com/finance/980416/ashanti_ag_1.html).

A privately held Australian company, Afrika Mashriki Gold Mines, has been active on the Nyabirama and the Nyabigena prospects in the Musuma-Mara district near the town of Tarime, on the eastern side of Lake Victoria near the border with Kenya. The company has identified a resource of 10 Mt, grading 3.0 g/t. Anglo American is managing the development of the project which is scheduled to produce 4,000 kg/yr of gold beginning in 1999 (Mining Journal, 1997).

Exploration at Tan Range Exploration Corp. of Canada's Itetemia project was interrupted in early 1997 by the presence of 1000 illegal artisinal miners working the surface outcropping of a gold-bearing reef on the property; an agreement, however, was reached with the miners to continue working temporarily, and Tan Range proceeded with exploration of the Golden Reef structure and for possible extensions of the adjacent Bulyanhulu gold mineralization (Tan Range Exploration Corp., 1997). In early 1998, Tan Range entered a three-phase option venture with Minorca Resources Inc. of Canada, whereby Minorca can earn a 50% interest in Tan Range's Itetemia gold property by paying $10 million and completing a bankable feasibility study (Northern Miner, 1998).

In other gold exploration activity, East African Gold Corp. of Australia was encouraged to continue exploration on their Kitongo and Rwamagaza projects on the basis of favorable drilling results in 1997. Tanganyika Gold NL of Australia continued work on its Buhemba project and on the Busolwa project on its Mawe Meru license, 40 kilometers (km) south of Geita. Near-surface resources at Buhemba were reported to be 11.45 Mt, grading 2.03 g/t, and containing 23.2 t of gold (African Mining, 1998). In December 1997, Tanganyika Gold announced plans to merge with, and absorb as a subsidiary Panorama Resources NL of Australia. Anglo American also held a 14.9% equity interest in Tanganyika Gold and was committed to expend $2 million during 2 years in the exploration of Tanganyika Gold's Lupa Goldfield licences. Maiden Gold NL of Australia held 11 prospecting licences in southern Lake Victoria greenstone environments with the major exploration focus in 1997 on the Nyanzaga prospect and the area around the old Jubilee Reef gold mine. Serengeti Diamonds Ltd. of Canada had a joint-venture arrangement with Ormonde Mining plc. of Canada to explore the Lyaru, the Kasanga Bridge and the Makhona-Nijwa gold prospects in the Lupa Goldfields. Ormonde also had a farm-in agreement with Iscor Ltd. of South Africa whereby Iscor could earn a 50% interest in the Ormonde's Mrangi prospecting license in the Seka area. In 1997, JCI Ltd. of South Africa sold their interests in four Tanzania gold exploration projects—Busolwa, Nzega, Minala, and Ibingo—to Kimberley Resources N.L. of Australia in return for a 37.8% interest in Kimberley.

In April 1997, Sutton Resources Ltd. terminated its joint venture with BHP Minerals International Exploration Inc., on its Kagera nickel-cobalt project in northwestern Tanzania. As a result, Sutton regained a 100% interest in the Kagera and the Kabanga nickel properties. In July 1997, Sutton entered a new joint venture agreement with Anglo American and granted them the right to earn a 60% interest in the separate Kabanga prospect by committing to spend $27 million, including at least $7 million within 24 months, on exploration, feasibility studies and arrangement of project financing. Total inferred resources at the Kabanga deposit, on the basis of earlier Sutton exploration and a 0.5% nickel cutoff, were estimated to be 31 Mt, grading 1.5% nickel, 0.22% copper, and 0.13% cobalt. Subject to final feasibility and financing decisions, Anglo American expected the capital cost to establish a mine and associated facilities capable of producing from 13,600 to 18,100 metric tons per year (t/yr) of nickel at $135 million. A 2001 production startup date was targeted (Sutton Resources Ltd., July 21, 1997, Sutton Resources Ltd. joint ventures Kabanga nickel project, accessed August 23, 1997, at URL http://www.suttonresources.com/s/NewsReleases.asp?ReportID=692). On the basis of a recalculation of the Kabanga resource by Anglo American based on a cutoff grade of 1.2% nickel, Sutton reported a revised estimate of 12.7 Mt, grading 2.1% nickel, 0.30% copper and 0.16% cobalt (Sutton Resources Ltd., February 21, 1997, Property profile—Kabanga and Kagera projects—Tanzania, accessed August 23, 1998 at URL http://www.suttonresources.com/s/Properties.asp?PropertyInfoID=114&View=All).

Other mineral production focused on diamonds, gemstones, and graphite. Williamson Diamonds Mines Co. Ltd., owned 75% by De Beers Centenary Ag. and 25% by the State Mining Corp., operated the Williamson (Mwadui) Mine. Williamson has produced more than 3 Mt of diamond ore since De Beers acquired the mine in 1995. Plant capacity is 1.7 Mt/yr. Current production levels were equivalent to 300,000 carats per year valued at about $10.4 million (Africa Trade and Business Bulletin, October 23, 1997, Tanzania Company News, The Williamson Diamonds Mines Co. Ltd., accessed November 17, 1997 at URL http://www.bizafrica.com/tanzania/busbul/companies.html). Additional diamond exploration was being conducted by De Beers, Reunion Mining of the United Kingdom at Mabuki, Tan Range at the Tabora kimberlite pipe 65 km southwest of the Williamson Mine, and Serengeti Diamonds Ltd. of Canada.

In 1996, Samax transferred its management of the Graphtan Ltd. graphite mine, near Merelani, northern Tanzania, to Phoenix Minerals Ltd. of the United Kingdom for $2.5 million. The $20 million mine, which began production in 1995, produced 6,776 t of graphite in its first full year of production in 1996. Sufficient reserves were initially identified for a 40-year operation at a mining rate of 15,000 t/yr of high-grade flake graphite of 97-98% purity (Ministry of Water, Energy and Minerals, Tanzania, 1998). The mine, however, ran into operational problems in 1997, and the last shipment of remaining stockpiled ore was made in February 1998. The mine will be put up for sale in 1998 (Industrial Minerals, 1998).

In the cement sector, the South African company, Alpha Ltd., acquired a 60% stake in the country's largest cement plant, Tanga Cement. Tanga had a production capacity of 500,000 t/yr of cement and held 40% of the market share in Tanzania (African Mining, 1997; International Cement Review, 1996).

In the energy sector, Tanzania has been heavily dependent on petroleum imports to meet its industrial energy needs; approximately 96% of the energy for domestic use comes from firewood (Kayaya, 1997). In addition to small production from the Kiwiri Coal Ltd. underground coal mine at Songwe-Kiwiri, the Central Mine Planning and Design Institute of India was conducting exploration drilling and a feasibility study on developing a surface mine and a mine-mouth powerplant in the Muchuma sector of the Ruhuhu coal field, where more than 200 Mt of bituminous coal had been identified in Karoo System rocks

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west of Lake Nyasa (Mining Magazine, 1997; Hestor, B.W., ed., 1998). During the past 2-3 years, the Government has been trying to privatize its controlling interests in petroleum refining and exploration. The state-owned Tanzanian Petroleum Development Corp. has entered production sharing agreements with a number of companies to explore offshore oil and gas targets, while reducing its maximum participation in the agreements to 20%. These include Antrim Resources Inc. of Canada on the Pemba-Zanzibar blocks, Canop Worldwide Corp. of Canada on the Dar es Salaam Basin, Tanganyika Oil Co. on the Rufiji and Mandawa Basins, Tullow Oil plc of Ireland on the Mnazi Bay Block; Dublin International Petroleum Ltd. of Ireland, and Klosa of Dubai.

In 1997, the Ocelot Energy Inc. and Trans Canada Pipelines Ltd. Canadian joint venture, under contract to the Government, began development of the $300 million Songo-Songo offshore gas production and processing project to deliver gas to a Dar es Salaam power station in 1998. During 1997, there was considerable progress on Ocelot's Songo-Songo gas-to-electricity project. All five existing gas wells in Songo-Songo were reworked and made production ready. Testing confirmed total gas deliverability of more than 2.8 million cubic meters per day (Mm^3/d) at high pressure. The first phase of the project required only 1.12 (Mm^3/d) of deliverability and 7 billion cubic meters of reserves, leaving capacity for subsequent phases of gas sales from Songo-Songo. At yearend, the company was awaiting the signature on final agreements that will allow the construction of a gas plant and pipeline to link Songo-Songo to an already constructed electrical power plant at Dar es Salaam (Ocelot Energy Inc.1998, Annual Ocelot Energy report for 1997, accessed September 22, 1998 through URL http://www.sedar.com or at http://www.ocelot.ca).

The future outlook for the minerals sector in Tanzania is promising, stimulated by positive new mining and foreign investment legislation and by the success of mineral exploration in the country within the past 2 to 5 years. Decisions on proceeding with future new mining developments, particularly for gold and nickel, however, will be subject to external market forces and world commodity prices. Lack of adequate infrastructure remains a problem, but efforts, supported by international development funds, have begun to upgrade harbors, pipelines, and road and railroad transport systems. The development of domestic natural gas resources should help in cost-saving energy import substitution and as a source of cheaper energy for new industrial developments.

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Geological Survey of Tanzania
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Tanzania Investment Centre
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Fax: 255-51-112761

Other Publication

Mining Journal [London], Tanzania Country Supplement, October 24, 1997, v. 329, no. 8452, 16 p.

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TABLE 1
TANZANIA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/		1993	1994	1995	1996	1997 e/
Calcite		180	540	37	40 r/ e/	40
Cement, hydraulic e/		540,000	490,000	800,000	800,000	800,000
Clays:						
Bentonite e/		70	70	70	75	75
Kaolin		-- e/	541	596	1,332	1,300
Coal, bituminous		51,270	45,000	43,200	52,000	35,000
Diamond 4/	carats	40,847	17,177	49,538	126,670	115,750 5/
Gemstones, precious and semiprecious excluding diamond	kilograms	34,826	48,509	111,403	142,160	142,000
Gold, refined	do.	3,264	2,861	320	318	300
Graphite		--	--	359	6,776	11,000
Gypsum and anhydrite, crude		1,205	7,536	1,052	8,765	8,800
Lime, calcined and hydrated		356	101	-- e/	-- e/	--
Limestone, crushed		527,120	648,474	1,062,081	120,000	120,000
Mica, sheet		(6/)	(6/)	(6/)	(6/)	(6/)
Phosphate minerals:						
Apatite e/		11,400	--	6,700 r/ e/	3,380	3,000
P_2O_5 content 7/		3,541	--	2,080 r/ e/	1,050 r/ e/	930
Salt, all types		17,740	84,289	105,000	86,700	90,000
Sand, glass e/		4,200	4,200	4,200	4,200	4,200
Soda ash e/		300	300	300	300	300
Tin, mine output, Sn content		12	9	3	-- e/	--

e/ Estimated. r/ Revised.

1/ Includes data available through August 11, 1998.

2/ Estimated data are rounded to three significant digits.

3/ In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

4/ Diamond figures are estimated to represent 70% gem-quality or semigem-quality and 30% industrial-quality stones.

5/ Reported figure.

6/ Less than 1/2 unit.

7/ P_2O_5 figures are reported and represent 31% of estimated apatite ($Ca_5Cl(PO_4)_3$) output.

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THE MINERAL INDUSTRY OF

TOGO

By Philip M. Mobbs

Agriculture, phosphate mining, and regional trade continued to dominate Togo's economy. In recent years, phosphate production and exports have accounted for 20% to 30% of export earnings, 10% to 13% of Government revenues, and 6% to 10% of the gross domestic product, respectively. Besides phosphate rock for export and limestone for cement, exploitation of minerals in Togo was negligible. There was some artisanal recovery of diamond and gold.

A number of smaller-scale mineral occurrences were known and cited by the Government as potential artisanal or semi-industrial operations including aggregate, attapulgite, bentonite, brick clay, diamond, dolomite, glass sand, gold, limestone, marble, peat, phosphate, rutile, and dimension stone (Ministry of Mines, Energy, and Water Resources, 1995). In addition, the Ministry had documented barite, bauxite, garnet, gypsum, iron ore, kaolin, kyanite, manganese, and monazite occurrences. For more extensive coverage of the mineral industry of Togo, see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

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TABLE 1
TOGO: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Cement e/ 3/		350,000	350,000	350,000	350,000	350,000
Iron and steel, semimanufactures e/ 4/		--	500	500	500	--
Phosphate rock, beneficiated product:						
Gross weight	thousand metric tons	1,794	2,149	2,570	2,731	2,200
P_2O_5 content e/	do.	540	800	930	980	800

e/ Estimated.
1/ Includes data available through August 14, 1998.
2/ In addition to the commodities listed, Togo presumably produced a variety of crude construction materials (clays, sand and gravel, and stone) but output is not reported, and available information is inadequate to make reliable estimates of output levels.
3/ Produced from imported clinker.
4/ Iron rod production from semifinished metal.

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THE MINERAL INDUSTRY OF

TUNISIA

By Bernadette Michalski

Production and processing of crude oil, and mining of phosphate rock and manufacturing of its derivative products were the most important segments of the Tunisian minerals industry in 1997. The mining and processing of metal ores were considerably reduced since the closure of the Bougrine lead-zinc mine in 1996 but should improve with the reopening of the mine in 1998. All segments of the minerals industry combined contribute about 3% to the nation's gross domestic product.

The laws governing hydrocarbon exploration and production were updated on June 12, 1990, by the Tunisian Parliament. This amendment, law No. 90-55, was designed to encourage foreign companies to engage in oil and gas exploration and development. The law was under revision in 1997 with the objective of harmonizing the existing laws into a single code and to improve the terms for foreign operators. The Government's hydrocarbon interests were overseen by the Enterprise Tunisienne d'Activités Pétrolières (ETAP), which maintained an interest in each licensed tract.

In the interest of accelerating privatization, foreign investors were permitted to buy up to 30% of any offered Tunisian company without prior authorization.

Appreciable increases in Tunisia's base metals industry were reported in 1994 and 1995 with the commissioning of the Bougrine zinc-lead mine; mining operations at Bougrine, however, were suspended in October 1996. Breakwater Resources of the United States acquired the assets of Bougrine for $19.3 million and planned to spend $7 million to upgrade the mine. The company anticipated production of 48,500 metric tons (t) of zinc concentrates and 5,800 t of lead concentrates in 1998 before reaching maximum production of 83,000 metric tons per year (t/yr) of zinc concentrates and 10,000 t/yr of lead concentrates in 1999 (Metal Bulletin, 1997).

The production of natural gas increased appreciably with the development of the Miskar Field, Tunisia's only domestic source of nonassociated natural gas. The production of crude oil continued a slow decline as the nation's largest field, El Borma, nears depletion. *(See table 1.)*

The European Union (EU) dominated Tunisian trade, accounting for 78% of total exports and 73% of total imports in 1997. France was Tunisia's main trading partner, accounting for one-fourth of Tunisia's total trade followed by Italy, accounting for one-fifth (Institut National de la Statistique, 1997). Imports in 1997 totaled $9,517 million,[1] of which mineral imports accounted for $1,236 million. Petroleum imports alone were valued at $639 million. Exports in 1997 totaled $6,640 million. The value of mineral exports was $1,353 million, of which phosphate rock and its derivatives were valued at $629 million. About one-third of Tunisia's export earnings was absorbed in debt servicing.

Phosphate rock extraction was entirely controlled and operated by the Government parastatal Compagnie des Phosphates de Gafsa, the largest company in Tunisia. Le Groupe Chimique Tunisien controlled phosphate processing through its Tunisian-owned Société Industrielle d'Acide Phosphorique et d'Engrais and Société Arabe des Engrais Phosphates et Azotes. Société Minière du Nord-Ouest operated a lead-zinc-barite mine at Boujabeur and a zinc mine at Hassine. The parastatal Société du Djebel Djerissa produced iron ore from the underground mine at Djerissa and from the open-pit operations at Tamera and Douaria. Hydrocarbon exploration and production were overseen by a series of production-sharing agreements between foreign operators and the Tunisian Government-controlled ETAP, usually with ETAP holding a 45% to 50% equity.

Tunisian phosphate rock mining was primarily in the Gafsa region from nine open-pit and underground sources. Phosphate rock exports were 1.25 million metric tons (Mt) in 1997 compared with 1.21 Mt in 1996. A significant increase was reported in phosphoric acid exports, which totaled 1.34 Mt compared with 1.20 Mt in 1996. Diammonium phosphate and triple superphosphate exports were reduced from the previous year's levels by 10% and 5%, respectively. The phosphate derivatives industry was dependent upon imports for part of its feedstock. In 1977, sulfur imports totaled nearly 1.7 Mt, and ammonia imports were 270,100 t.

The Tunisian Government plans to develop a dump for phosphate wastes at Sebkat al-Malah, about 30 kilometers (km) northwest of Gabes. This action is taken in response to the 10,000 to 20,000 metric tons per day of waste that was being dumped in the Gulf of Gabes polluting the central and southern coastal areas. The cost of the facility will be $100 million and was expected to be operational by 1999.

Natural gas supplies were derived from domestic output, Algerian pipeline transit fees payment in kind, and supplemental purchases from Algeria. Until the development of the Miskar Field in 1996, associated natural gas from the El-Borma Field was Tunisia's sole domestic natural gas source in this decade. Two natural-gas-processing plants were in operation. The Hannibal plant produced condensate for export and dry gas for power generation and other industrial uses. The Gabes plant processed El-Borma associated gas for production of butane and propane (Arab Petroleum Research Center, 1997).

The Trans-Mediterranean Pipeline (TransMed), which transited Tunisia to deliver Algerian natural gas to Italy, has supplied Tunisia with between 600 and 900 million cubic meters per year

[1]Where necessary, values have been converted from Tunisian dinars (TD) to U.S. dollars at a rate of TD0.92=US$1.00.

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(Mm^3/yr) of natural gas since 1983 as a transit fee. The transit fees are expected to increase as further usage is made of the newly expanded TransMed. In March 1997, ETAP signed an agreement with Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialization des Hydrocarbures (SONATRACH) of Algeria covering the delivery of 400 Mm^3/yr of natural gas for the next 23 years, in addition to the amount supplied in payment of transit fees.

Increased domestic consumption and declining output from larger oilfields continued to stress the petroleum sector. Crude oil production totaling more than 74,000 barrels per day (bbl/d) was derived from 23 fields, the largest of which is the El-Borma Field operated by Italy's Azienda Generali Italiana Petroli, output averaged nearly 30,000 bbl/d of 41° API gravity crude oil. The offshore Ashtart Field accounted for nearly 22,000 bbl/d of 30° API gravity oil as the result of a $210 million secondary development program. Formerly owned by France's Société Nationale des Pétroles in partnership with ETAP, the 50% interest in the Ashtart Field was sold to Atlantic Richfield (ARCO) of the United States in mid-1997. ARCO also owned 100% interest in the South Kerkennah exploration block located immediately to the west of the Ashtart license.

Union Texas Petroleum of the United States acquired its third Tunisian interest in late 1997 with the purchase of a 25% working interest in the Burj El Khadra block from Phillips Petroleum Company, Tunisia. The concession comprised a total of 5,816 square kilometers for which 1,500 km of two-dimensional seismic data have been acquired. An exploration well will be drilled in 1999. In the event of a commercial discovery, ETAP has the right to participate for up to 50% of the working interest in the field. The Burj El Khadra block is adjacent to the Burj Messouda block in the Ghadames Basin across the border in Algeria where a number of significant discoveries have been made (Union Texas Petroleum, 1997, Union Texas Petroleum joins exploration venture in Ghadames Basin in Tunisia, press release, accessed October 3, 1997, at URL http://biz.Yahoo.com/prnews).

Petroleum refining was confined to a single 35,000-bbl/d capacity refinery at Bizerte, operated by the Société Tunisienne des Industries de Raffinage. The refinery output accounted for more than one-half of the nation's petroleum product requirements. In March 1997, the Tunisian Government firmed plans to build a 120,000-bbl/d refinery at La Skhirra, 280 km south of Tunis. The second refinery would raise the nation's refined product capacity to 154,000 bbl/d, or about twice the nation's petroleum product requirements.

Tunisian phosphate rock reserves are 3.5 billion to 4 billion metric tons, or about 5% of global reserves. Tunisian crude petroleum reserves are 410 million barrels. Reserves of natural gas were 80 billion cubic meters (Arab Petroleum Research Center, 1997). The minable reserves at Bougrine were 5.3 Mt grading 11.7% zinc and 2.6% lead.

A total of 2,260 km of railway was the primary mode of transportation of phosphate rock to chemical plants and seaports. Highways within Tunisia totaled 17,500 km. Crude oil pipelines were 797 km long, and natural gas pipelines totaled 742 km. Tunisia had an installed electrical generation capacity of 1,500 megawatts. Combined cycle power stations, which generate electricity from natural gas, remained a construction priority.

The mineral industry was an integral part of the country's economic future. Investments in heavy industry and a new export-directed economic policy combined with Tunisia's advantageous low labor costs and proximity to European and Middle Eastern markets should enable Tunisia to evolve as a regional manufacturing center. Economic and technical cooperation with the members of the European community should substantially increase as Tunisia concluded an Association Agreement with the EU in July 1995. The agreement provided for the creation of a free trade area for a 12-year period.

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TABLE 1
TUNISIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
METALS						
Iron and steel:						
Iron ore and concentrate, gross weight	thousand tons	299	288	224	238	252
Fe content	do.	153	129	122	129	137
Metal:						
Pig iron	do.	165	154	162	151	152
Steel, crude	do.	183	184	201	187	195
Lead, mine output, Pb content		863	2,856	6,601	4,764	1,424
Silver metal, primary e/	kilograms	900	2,500 r/	4,000 r/	3,000 r/	1,000
Zinc ore, gross weight		2,389	23,379	80,446	58,044	5,389
Zn content		1,350	14,548 r/	44,244	31,920	2,967
INDUSTRIAL MINERALS						
Barite		15,289	15,732	10,825	15,360	12,841
Cement, hydraulic	thousand tons	4,269	4,606	4,998	4,566	4,431
Clays, construction e/	do.	350	350	350	350	350
Fertilizers:						
Triple-superphosphate	do.	651	830	818	791 r/	748
Phosphoric acid	do.	858	986	1,018	1,093	984
Diammonium-phosphate	do.	749	741	830	928	745
Ammonium nitrate	do.	182	112	193	186	349
Fluorspar, acid grade		1,399	676	1,856	720 r/	1,426
Gypsum e/		100,000	100,000	100,000	100,000	100,000
Lime e/	thousand tons	600	600	600	600	600
Phosphate rock:						
Gross weight	do.	5,476	5,565	7,241	7,167	6,941
P_2O_5 content e/	do.	1,630	1,712	2,181	2,150	2,140
Salt, marine	do.	435	414	481	477	393
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross e/	million cubic meters	250	354	335	1,027	1,866
Dry	do.	200	250	250	800 e/	1,500
Petroleum:						
Crude	thousand 42-gallon barrels	35,770	33,660	32,690	32,229	26,841
Refinery products:						
Liquefied petroleum gas	do.	1,460	1,545	1,465	1,573	1,353
Gasoline	do.	2,448	2,917	2,846	3,040	3,179
Kerosene	do.	1,141	1,057	1,035	1,012	827
Distillate fuel oil	do.	3,678	4,003	4,297	4,261	4,842
Residual fuel oil	do.	3,004	3,876	4,300	4,292	3,956
Other e/	do.	400	448	568	551	1,995
Total	do.	12,131	13,846	14,511	14,729	16,152

e/ Estimated. r/ Revised.

1/ Data available as of May 1, 1998.

2/ In addition to the commodities listed, a variety of crude construction materials (sand and gravel and stone) was produced, but output was not reported, and available information was inadequate to make reliable estimates of output levels.

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THE MINERAL INDUSTRY OF

UGANDA

By Philip M. Mobbs

The contribution of Uganda's mineral production to the nation's economy was minimal in 1997. Prior to the economic and political upheaval of 20 years ago, the Ugandan mineral sector had accounted for about 30% of the gross domestic product (GDP). In 1996-97, the agriculture sector accounted for 44% of the GDP compared with the minerals sector's contribution of about 3%.

Mining was regulated by the Mining Act of 1964, the Investment Code of 1991, and the Income Tax Act of 1997. An updated mining code was being considered by Parliament. Mineral industry activities were administered by the Ministry of Natural Resources. The Ministry's Department of Geological Survey and Mines issued prospecting, location and mineral dealer licenses; mining leases; and water rights. The Ministry's Commissioner for Energy and the Directorate of Energy and Mineral Development set energy sector policies. The Uganda Investment Authority, the Government agency responsible for investment promotion, operated a one-stop center to facilitate investment ventures.

Gold exports reached a total of 6,819 kilograms (kg) in 1997 compared with 5,067 kg in 1996, 3,093 kg in 1995, and 225 kg in 1994 (Gerald M. Sendaula, Ministry of Natural Resources, written commun., May 6, 1998). The increase has been attributed to the abolishment of the Central Bank's monopoly on gold purchases in 1994 and to gold mined in the Democratic Republic of the Congo (Kinshasa) and brought into Uganda (Indian Ocean Newsletter, 1998).

The Government was actively promoting the development of the nation's mineral resources. Reflecting the shift in interest as international gold prices dropped, most of the prospecting licenses issued in 1997 covered exploration for base metals, gold, and silver; in 1996, most of the licenses in effect had been for gold only. The Government was helping local mining entrepreneurs search for international joint-venture partners and financing. To the Government's dismay, some gold prospecting licenses appear to be used by international companies to maintain a presence in the gold districts instead of being active mineral prospects (Crespo Sebunya, March 1998, correspondent, NewAfrican, accessed October 14, 1998, at URL http://dialspace.dial.pipex.com/town/terrace/lf41/na/mar98/nambo0302.htm).

During October, the Karnag Consortium of Cyprus agreed to investigate the feasibility of resuming phosphate mining in the Sukulu Hills. The Government was interested in having other closed mineral operations, such as the salt works and several tin and tungsten mines, reopened. Additional Ugandan mineral resources reported to have the potential to attract commercial investment include diatomite, dimension stone, gypsum, iron deposits, mica, nickel, and vermiculite (Hester and others, 1996). Although prospecting licenses were staked all over the country, the mining licences (15) were in the southeast and southwest. Active anti-Governmental rebellions continued, impeding exploration activity in the north and northwest.

Kasese Cobalt Co. Ltd. (KCCL) secured a $66 million construction loan to recover cobalt from Kilembe Mine concentrates stockpiled near the Kasese railhead in southwestern Uganda. KCCL was raising an additional $44 million from its owners, Banff Resources Ltd. of Canada, the state-owned Kilembe Mines Ltd., International Finance Corp., Proparco of France, and private Ugandan investors. Construction of the KCCL infrastructure and preparation of the plant-site were completed in 1997. Bioleaching of the concentrates, solvent extraction, and electrowinning were not expected to begin until late 1998, with commercial production scheduled for early 1999. Plans were to process the stockpiled concentrates to recover approximately 1,000 metric tons per year of cobalt cathode. Operations were expected to extend over a period of 11 or 12 years.

Gold was recovered by artisanal miners in the northeast and along the western border. Seven nickel prospecting licenses held by Equatorial Resources Ltd. and Nickelfields Uganda Ltd., local subsidiaries of Pacific Vanguard Mines Ltd. of Canada, and Prospecting License 4150 were transferred to Nhlanhla Ltd., a joint venture of Pacific Vanguard, Ketch Trading Co. of Switzerland, and GHK Resources Ltd. of Canada. The Nhlanhla properties subsequently were sold to Ruwenzori Exploration (Uganda) Ltd. in October 1997. Ruwenzori is a joint venture of Avmin Africa Holdings B.V. (70%), a subsidiary of Avmin Ltd. of South Africa, and Nhlanhla (30%).

Companies reporting activity on exclusive prospecting licenses or special exclusive prospecting licenses included African Mineral Exploration; Africa Mines Holding Ltd.; Al Kayan Minerals; Anglo-Ugandan Corp. plc; Bisya Mines Ltd.; Butologo Gold Mines; Branch Energy (Uganda) Ltd.; Falcon Mining Co. Ltd.; Global Resources (Uganda) Ltd.; Gold Empire Ltd.; Goldstar Minerals (Uganda) Ltd.; Karo Mines Uganda Ltd.; Kaygee Resources Ltd.; Kigezi Twimuke Co., Ltd.; Kitara Mining Co. Ltd.; Lincoln Exploration Ltd.; MLS Lime Co.; Mukasa Prospecting and Mining Co. Ltd.; Nabisoga Mining Ltd., an affiliate of Uganda Gold Mining Ltd. of Canada; Nayim Resources Ltd.; New Ensign Resources Ltd., an affiliate of Glencar Mining plc of Ireland; Protocol Resources; Rift Resources Ltd. of Canada; Rockman International Ltd.; Roraima Mining Co. Ltd., an alliance of International Roraima Gold Corp. of Canada and ISCOR Ltd. of South Africa; Ruhabguro Tin, Wolfram, and Bismuth Mines Ltd.; Ruwenzori; Saudi Marble (Uganda) Ltd.; Shield Mining Co.; and Union Minerals (Department of Geological Survey and Mines, written communication, 1998). Other companies holding prospecting licenses in 1997 included African Fields Ltd.; Africa

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Resources Ltd.; BNG International Enterprises (Uganda); Catalyst Ventures Corp. of Canada, which acquired interest in the Kaabong Project from Branch Energy (Uganda); Dobrana Resources Ltd. of Canada; Echo Resources Ltd.; Gold and Gems Partners (Uganda) Ltd.; International Foundation for Mining and Development; Kadam Mining Co.; United African Mines Co. Ltd.; and Zamak (Uganda) Ltd.

African Selection Mining Corp. of Canada and Anglo-Ugandan Corp. terminated their joint venture on the Kamalenge gold license in December 1997 after negative exploration results. Pangea Goldfields (Uganda) Ltd. wrote off its two gold exploration concessions. Tusker Exploration Ltd. allowed nine gold prospecting licenses to expire in 1997.

Heritage Oil and Gas Ltd., a London-based Bahamian company, was working on its Block 3 concession in the southern Lake Albert Basin and around Semliki Flats. In November, Hardman Petroleum (Uganda) Pty. Ltd. (45%), Planet Oil Holdings Ltd. of the United Kingdom (45%), and Balmain Resources Pty. Ltd. of Australia (10%) secured a production-sharing agreement for Block 2 in the northern portion of the Lake Albert region.

The Government's Road Sector Development Program, initiated in 1996, is a 10-year $1.5- billion project intended to reconstruct 4,000 kilometers (km) of road and to repair the nation's 30,000-km road network. Surface transport suffered setbacks in late 1997 as torrential rains damaged bridges and highways. Flooding associated with the rains periodically halted rail traffic. The railway connected Kasese, Kampala, and Tororo in Uganda with the port of Mombassa, Kenya. A rail ferry connected Port Bell, near Kampala, with Mwanza, Tanzania, which was connected to Dar Es Salaam, Tanzania by rail. Also in 1997, a feasibility study was begun to review the extension of the petroleum products pipeline from western Kenya into Uganda. Petroleum products currently are imported by truck through Kenya and Tanzania.

With its booming economy, Uganda has been subject to electric power deficits since the early 1990's. Besides domestic demand, the Uganda Electricity Board (UEB) was saddled with a long-term contract to supply 30 megawatts (MW) to Kenya. Intermittently, smaller amounts of electric power were sold to Tanzania and Rwanda. Power was generated by the 160-MW-capacity Owen Falls hydroelectric dam, supplemented by smaller hydroelectric generation facilities near Kabale and Kasese. UEB also obtained power from diesel plants near Arua, Kampala, Kitgum, Mbale, Moroto, Moyo, and Nebbi. Three sugar factories generated electric power by burning bagasse, adding about 5 MW to the nation's power supply.

Impregilo SpA and Salini of Italy were contracted to finish the Owen Falls Dam expansion begun by SIETCO of China. Arabian International Construction of Egypt began a feasibility study on a proposed 450-MW Kalagala hydroelectric powerplant about 15 km downstream from Bujagali Falls. Nile Independent Power Co., a joint venture of AES Corp. of the United States and Madhvani International of South Africa, was to build a 290-MW hydroelectric-generating plant on the Victoria Nile; power was not expected to be available to the Uganda grid until 2003. An 180-MW hydroelectic powerplant also was proposed for the Karuma Falls area.

Uganda's economy continued to expand despite the unrest in the Central African region and the rebellion in northern Uganda. Its mineral resources are underexplored and underdeveloped. The legacy of the Mineral Development Promotion Program which ended in June 1996, combined with the downturn in the price of gold is the expectation that the Ugandan mineral industry will have more opportunity to diversify through the coming years. Successful mineral exploration activities should attract additional international interest and investment in the nation's mineral industry. Gold exports are expected to tumble as less gold is brought into Uganda from the Congo (Kinshasha). Growth of energy-intensive mineral processing may be limited during the next 5 to 6 years by the UEB's power problems.

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TABLE 1
UGANDA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996 e/	1997 e/
Cement, hydraulic		50,000 e/	42,000	85,000	150,000	150,000
Columbium-tantalum	kilograms	452	435	1,842	2,000	2,000
Gold	do.	291	1,627	1,506	2,954 3/	3,000
Gypsum		308	201	1,538	3,000	3,000
Iron ore		--	--	7	200 3/	200
Lime, hydrated and quick		1,024	163	970	1,000	1,000
Limestone e/		46,000	38,000	78,000	135,000	135,000
Phosphate minerals, apatite		--	--	20	-- 3/	--
Salt, evaporated		10	10	10	10	10
Steel		20,000	10,000	12,000	12,000	15,000
Tin, mine output, Sn content		3	3	43	(4/) 3/	(4/)
Tungsten, mine output, W content		5	12	17	-- 3/	--

e/ Estimated.

1/ Includes data available through October 19, 1998.

2/ In addition to the commodities listed, the following are presumably produced but information is inadequate to estimate output: clay, copper content of slag, corundum, garnet, gemstones, gravel, kaolin, marble, ruby, sand, and vermiculite.

3/ Reported.

4/ Less than 1 unit.

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THE MINERAL INDUSTRY OF

ZAMBIA

By George J. Coakley

Zambia is a landlocked country in southern African with an area of 753,000 square kilometers, 9.5 million people, and a per-capita gross domestic product (GDP) based on purchasing power parity of $950.[1] Overall, mining and quarrying contributed to 5.9% of real GDP in 1996, the latest year for which data were available, and to about 10% of total employment. Copper and cobalt production by the state-owned Zambian Consolidated Copper Company Limited (ZCCM) continued to be the major component of the minerals sector of the Zambian economy accounting for between 70% and 80% of total export earnings.[2] Zambia ranked as the world's largest producer of cobalt, 11th in copper, and as one of the top producers of gem-quality emeralds in 1997. Gemstones, mostly emeralds, also recorded significant earnings, but probably an even larger amount bypassed official channels. The so-called Copperbelt area of north-central Zambia and adjacent southeast Congo (Kinshasa) contain one of the greatest concentrations of high grade copper-cobalt resources in the world. Besides copper and cobalt, Zambia produced a wide variety of metallic and industrial commodities, along with coal *(See table 1)*.

Despite the economy's dependence on copper and cobalt revenues, the Government's past practice of diverting mineral earnings for various social or other economic purposes while neglecting the need for reinvestment in the industry has led to a progressive decline in copper production and revenue. Efforts to privatize ZCCM were only partially successful in 1997, with the lack of new outside investment contributing to a further deterioration of its productivity. By the end of 1997, ZCCM loses of about $25 million per month were creating a serious foreign exchange liquidity problem in the country (Mining Annual Review, 1998). Efforts by Zambia to secure additional support from the international financial and development institutions to make payments on more than $7 billion in foreign debt were being tied to the completion of the ZCCM privatization.

Government Legislation and Policies

Legislation

The Investment Act of 1993 established the Zambia Investment Center as a one-stop support facility for investors and offers incentives to investors in the mining sector. In December 1994, the Government had announced that it would no longer participate in exploration or become a shareholder in a mining company and would limit its functions to regulatory or promotional activities. Subsequently, the December 1995 Mining Policy officially put in place a privatization program to encourage private development and diversification of the mining sector and to promote small-scale mining, development of gemstone mining and liberalization of gemstone marketing facilities, exploitation of industrial and energy minerals and development of ferrous minerals, reduction of ecological damage arising from mining, and local value-added processing of Zambia's mineral raw materials.

The Government continued to promote actively the private sector and to seek foreign investment, particularly in minerals. The purpose of the Mines and Minerals Act of 1995, passed by Parliament as 1995 Act No. 31 on September 13, 1995, is to attract risk capital, technology, and entrepreneurial efforts to the mining sector. The law covers all mineral commodities and treats large-scale, small-scale, and gemstone operations separately as to mineral rights (prospecting and mining authorizations). Export of radioactive minerals, such as monazite, is illegal without special Ministerial approval. It also gives the Government leeway in negotiating individualized contracts with investors. Among other provisions were secure title to mining rights with provision to assign; the right to market products; international arbitration; exemption from import duties and sales taxes on material, at least for an initial period of exploration and development; and royalty charges of 3% for large-scale mining license holders on the "net back value" of minerals free-on-board, less transport and smelting and refining costs.

Parliament's Environmental Protection and Pollution Control Act (No. 12) of 1990 formed the basis for a Ministry of Environment and Natural Resources and also an Environmental Council of Zambia. The act formally came into full force in February 1992 and gave the Ministry overall responsibility for protecting the environment. In March 1997, the Mines and Minerals (Environmental) Regulations were passed to implement environmental protection provisions of the Mines and Minerals Act of 1995. The 1997 environmental legislation established an environmental protection fund and regulations for environmental impact assessments, mine dumps, air and water quality and emission standards, storage, handling and processing of hazardous waste, and mines inspection.

Privatization

Since gaining independence in 1964, the Government has dominated the structure of the minerals industry for more than 30 years, but that is changing as privatization progresses. The Privatisation Act No. 21 of 1992 established the Zambia Privatisation Agency (ZPA) as an autonomous Government agency. Its functions are to plan, implement, and control the privatisation of state-owned enterprises in Zambia, in cooperation with the Government, by selling them off to companies that have the required capital and technology to run them. Details on ZPA

[1] Where necessary, values have been converted from Zambian Kwacha (K) to U.S. dollars at the rate of K1,695=US$1.00 for 1997 and K1,282=US$1.00 for 1996.

[2] Statistical and other technical data on ZCCM for 1997 used in this chapter have been taken from the ZCCM 1998 Annual Report, which covers the fiscal year April 1, 1997 to March 31, 1998.

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mission and operations are available through its website, accessible at URL http://www.zpa.org.zm. Efforts to privatize most of the more-than-200 Government-controlled companies, which were initiated in 1994, began to materialize in the mining sector in 1997. In late 1996, the Government issued an invitation to prequalify document, for the sale of majority interests in certain Government mining and electricity distribution assets by international tender. This included the sale of ZCCM, the country's major single enterprise. ZCCM had been formed in 1982 with the merger of Nchanga Consolidated Copper Mines Ltd. and Roan Consolidated Copper Mines Ltd., making it at the time the world's second largest copper company after Corporación Nacional del Cobre de Chile. The Anglo American Corp. subsidiary, Zambian Copper Investments also held a 27.3% minority interest in ZCCM.

In February 1997, the ZPA prequalified a total of 38 companies for the sale, including Australia's BHP Minerals International Exploration Inc. (BHP) and Western Mining Corp.; Canada-based Falconbridge Ltd., Indochina Goldfields Ltd., Noranda Inc., and Teck Corp.; China's China National Nonferrous Metals Industry Corp. (CNNC); the South African-based companies Gencor Ltd., Avmin Ltd., and Iscor Ltd.; and Phelps Dodge Corp. and Cyprus Amax Minerals Co. of the United States.

During 1997, as detailed below, five of the nine ZCCM privatization packages were sold, while negotiations were ongoing with the remainder.

- **Privatization Package A.**—In late 1997, the Kafue Consortium, comprised of Avmin, Phelps Dodge, Noranda, and Commonwealth Development Corp. won the rights to Privatization Package A—the Nchanga and the Nkana Divisions (excluding the Chambishi and the Kansanshi Mines) and their respective social assets. This package includes five underground mines and one open-pit mine, associated concentrator facilities, a tailings leach plant, a copper smelter and refinery, an acid plant, and a cobalt plant. These divisions represent about one-half of ZCCM's production capacity and were a key to completing the privatization of ZCCM. At yearend the companies continued their due diligence on the acquisition and negotiations with the ZPA on the final terms of the agreement. Discussions revolved around an offer by the Kafue Consortium for a several-hundred-million-dollar buy-in and a commitment to invest an additional $1 billion to expand operations, including $250 million in debt assumption and social development. Faced with declining copper prices and Zambian Government demands for a high up-front cash buy-in level, during the first quarter of 1998, negotiations collapsed, and both Phelps Dodge and Noranda withdrew from the consortium (Metal Bulletin, 1997b).

- **Privatization Package B.**—Binani Group, the Indian zinc producer, purchased the Luanshya Division (excluding the Ndola precious metals plant) and its associated social assets for $35 million— and commited to spend an additional $69 million in capital improvements. The Luanshya Division includes the underground copper mines at Baluba and Luanshya, and associated concentrator facilities, the closed Luanshya smelter and the Ndola Copper Refinery. The copper mines will operate as the newly incorporated Roan Antelope Mining Corporation of Zambia. The Zambian Government retained a 15% carried interest.

- **Privatization Package C.**—Negotiations were also ongoing for the sale of the Mufulira underground mine and concentrator, which produced approximately 48,000 metric tons (t) of copper in concentrate in 1997-98.

- **Privatization Package D.**—in November 1997, the Canadian investment company, Ivanhoe Capital Corp. acquired an 85% interest in the Chambishi copper mine (nonoperational) which had a resource base of 136 million metric tons (Mt) at 2.4% copper and an existing production shaft to the 900-meter (m) level, accessing about one-third of the resource *(See table 3)*. In January 1998, Ivanhoe Capital withdrew its bid as a result of financing difficulties (Gooding, 1998) and discussions were reopened with new bidders including CNNC.

- **Privatization Package E.**—Cyprus Amax purchased the Kansanshi copper mine for phased payments of $28 million—and committed to spend $20 million on exploration and feasibility studies. The Zambian Government retained a 20% carried interest. The Kansanshi Mine was closed at yearend, but Cyprus Amax will continue to explore for additional reserves through 1998.

- **Privatization Package F.**—no bids were received on the Nampundwe pyrite mine.

- **Privatization Package G.**—The Chambishi cobalt plant, which has a nominal capacity of 2,400 metric tons per year (t/yr), and its associated acid plant were included in the failed Kafue Consortium negotiations and then subsequently sold to Avmin in April 1998 for $50 million and a commitment to make $80 million in capital improvements.

- **Privatization Package H.**—The Ndola precious metals plant, which produces gold, silver, and selenium from copper refinery slimes, was being offered for sale to First Quantum Minerals Ltd. of Canada.

- **Privatization Package J.**—ZCCM's Power Division was purchased for $50 million by the British companies, Midlands Power International and National Grid Co. Plc. and five Power Division management staff and renamed the Copperbelt Energy Corporation (CEC). The Zambian Government retained a 20% interest. The CEC will continue to purchase electricity from the state-owned Zambia Electricity Supply Co. and sell it to Copperbelt mining operations and other customers. In 1995-96, ZCCM's own power consumption was approximately 5,000 gigawatt-hours with a peak demand of 500 megawatts (MW). The Power Division distributed two-thirds of Zambia's electricity.

In other privatization actions:

- **Chibiluma Copper Mines.**—The Metorex Consortium [Crew Group of Canada (29.75%); and its South African subsidiary companies, Maranda Mines Ltd. (25.5%) and Metorex (PTY) Ltd. (12.75%); and Genbel Securities (17%), a South African

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investment bank], acquired the Chibuluma South copper mine and deposit for $17.5 million and committed to invest $34 million on a new shaft and concentrator for the undeveloped Chibuluma South deposit within 5 years. The Zambian Government retained á 15% carried interest in Chibuluma.

- **Konkola Deep Mining Project.**—A consortium comprising of the Anglo American (40%), Falconbridge (30%), and Gencor (30%), signed a memorandum of understanding with the Government on February 11, 1997, to conduct a feasibility study to develop the Konkola Deep Mining Project. The agreement was contingent on completion of due diligence on the existing operations and on the final sale of the Nchanga and the Nkana Divisions. By year-end, however, Gencor had withdrawn from the consortium and was followed by Falconbridge in March 1998, leaving the future of the project uncertain. Plans had called for a $700 million to $800 million investment to develop Konkola Deep's proven reserves of 344 Mt grading 3.8% copper at a rate of 180,000 t/yr of copper (Zambia Investment Center, The privatization of Zambia Consolidated Copper Mines, accessed December 3, 1997 at URL http://www.gozambia.com/invest/fr/p_zccm.html, superceded byhttp://www.zic.org.zm).

- **Konkola North Copper Deposit.**—In March 1997, Avmin signed an agreement with ZCCM and the Government to obtain the mining rights to the Konkola North area. Korea Zinc will have a 30% equity interest in the project, and ZCCM, 15% to 20%. Avmin committed to spend about $13 million completing a 50,000-m exploration drilling program and a mine prefeasibility study within 2 years. If positive, then Avmin will commit $12 million to Phase II for another 24 months to complete exploration drilling and a final feasibility study (Avmin, 1997; Zambia Privatization Agency, February 1997, Sale and purchase agreement signed on ZCCM's Konkola North mining prospect, press release accessed April 1, 1997 at URL http://www.zamnet.zm/zamnet/zambus/zpa/konkola.htm).

- **Maamba Collieries Ltd.**—An 80% interest in the state-owned Maamba Collieries Ltd. was sold to Benicon Limited of South Africa in November 1997. Benicon assumed $16 million in net liabilities from the Government and promised to invest an additional $4.5 million in capital expenditures and refurbishment of the Maamba coal mine that was flooded during heavy rains in early 1997. Benicon's main activity was as a contract coal miner for Anglo American in South Africa (Chilombo Mwondela, November 27, 1997, Government retains 20% shares in Maamba Collieries, The Post, no. 861, November 27, accessed December 3, 1997 at URL http://www.zamnet.zm/zamnet/post.arch.29743/news/story8.html).

Production

In 1997, production ZCCM copper mines was 352,900 t, an increase of 5.6% from that of 1996; this was however, only at a rate equal to 43% of the 1969 peak production of 825,000 t. Estimated cobalt mine production declined by 13% and refined cobalt by 5% from that of 1996, still low by historical standards. Production of byproduct gold, selenium, and silver from ZCCM copper refinery slimes were all down from that of 1996, but overall gold production was up resulting from the startup of the new Dunrobin gold mine. In addition to ZCCM copper and cobalt production, Zambia is a major world supplier of emerald and amethyst and additionally produces gemstone quality aquamarine, garnet, and tourmaline. Most gemstone mining is done by small-scale artisanal miners, and production and export levels are poorly documented. Cement production increased by 10% while coal production dropped sharply following the flooding of the Maamba coal mine. Petroleum refinery products output probably were lower, based on reports of operating difficulties, but numerical information was not available for estimating any decline.

Trade

The major mineral exports by value were copper and cobalt. Some observers, however, believed gemstones were very significant in export value for some time, possibly second to copper, despite the absence of official records. The Government indicated that the value of legally and illegally exported gemstones may be as much as $250 million per year. For the fiscal year ending March 31, 1998, ZCCM reported sales, chiefly as exports, of $704 million of copper and $182 million of cobalt, down from $921 million and $202 million, respectively, in fiscal year 1996-97. The revenue decline was attributed primarily to the sharp drop in world commodity prices. ZCCM product sales of $964 million were distributed among the European Community (20.6%); Japan (15.6%); Saudi Arabia (10%); Thailand (8.1%); and India (7.9%). The difference between export and sales values may be small owing to domestic sales and to metals bought by ZCCM to meet customer contracts. Approximately 58% of bulk copper exports in 1997 were railed from Zambia to the Tanzanian port of Dar es Salaam; 15% via the Mozambican port of Beira; and 24% to 25% through the South African ports of East London and Durban.

The principal import was petroleum, including crude and refined products. The Arabian Gulf States were the principal sources of oil imports, and South Africa was a major source, at least partly because of transhipments from overseas sources. Fertilizer components were the second largest mineral import, particularly phosphorus and potassium. Mining equipment was the largest import from the United States.

Commodity Review

Metals

Cobalt.—Although cobalt mine grades held constant for the year, reduced availability of concentrates particularly to the Chambishi Cobalt Plant, led to an overall 5% decline in refined cobalt output. The Chambishi Cobalt Plant produced 2,208 t of refined cobalt compared with 2,328 t in 1996, and the Nkana Cobalt Plant produced 2,178 t of refined cobalt compared with 2,238 t in 1996. At Chambishi ZCCM reported to high lead levels in the refined cobalt caused by high manganese levels in imported quicklime. Geochemically, manganese is known to be a scavenger of other metals near its environment, apparently, in this instance, lead.

In August 1996, Qasim Mining Enterprises Ltd., owned 60% by Colossal Resources Corp. of Vancouver, Canada, started up its

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slag retreatment project designed to reprocess 8.6 Mt of cobalt slag grading 0.70% to 0.81% cobalt and 1.15% copper from ZCCM's Nkana slag dump. The processing center at Kabwe had two 15-t electric arc furnaces, and two induction furnaces with associated granulation units. Qasim produced a water-granulated and milled cobalt-copper-iron mixed-alloy powder product containing 10% to 12% cobalt. The company expected to process from 4,000 to 6,000 metric tons per month of slag during the first year of operation, resulting in 50 t per month of recovered cobalt. As of mid-1997, production was reported to be 3 to 4 metric tons per day (t/d) of 12% to 15% cobalt alloy, with second half production forecast at 20 t/d averaging 2.5 to 3 t of contained cobalt. Details of full-year operations were not reported by the company.

Caledonia Mining Corporation of Toronto, Canada, updated the tonnage and grade estimates on its Nama cobalt-copper oxide project to a total indicated and inferred resource of 953.4 Mt at 0.029% cobalt equivalent (Caledonia Mining Corporation, 1997). The company was undertaking further studies to determine the economics of developing the project to produce several thousand tons per year of cobalt from an open-pit mine, and by using a leach-solvent extraction-electrowinning (SX-EW) process and to examine the potential extension of the deposit into the Democratic Republic of the Congo (Congo-Kinshasa).

Copper.—Pending completion of its privatization program, ZCCM continued to operate one of the largest copper mining complexes in the world through five divisions, listed by decreasing production capacity, Nchanga, Mufalira, Nkana, Luanshya, and Konkola. The Nchanga Division operates one underground and one cobalt-rich open pit copper mine, the Nchanga mill, and a tailings leach plant. For the fiscal year ending March 31, 1998, Nchanga mined 7.32 Mt of copper ore grading 2.34% copper and 833,266 t of cobalt feed grading 1.19% copper and 0.51% cobalt. Concentrate production of 212,801 t was up 32% from that of 1996-97 with a copper recovery rate of 41.37%. Copper in concentrates produced was 70,583 t. The Nchanga leach plant treated 12.5 Mt of material grading 1.12% copper yielding 61,061 t of new copper cathode.

The Mufalira Division operated one major underground mine, a mill, smelter, and refinery. Following the privatization of the Luanshya Division on October 15, 1997, the Ndola Precious Metals Plant was transferred to the Mufalira Division. In 1997-98 Mufalira mined 2.34 Mt of copper ore grading 2.14%. The 17% drop in ore hoisted during the year was attributed to seismic problems and spare part supply problems on the jumbo drills. Concentrate production of 100,948 t, with a copper recovery rate of 96.42%, was down 22% from that of 1996-97. Smelter production was down by 20%, to 102,097 t and refined copper cathode production declined by 14% to 128,363 t.

The Nkana Division mined ore from four underground zones, Central Shaft, Chibiluma, that was sold to Metorex in October 1997, Mindola, and South Ore Body, and operated a mill, a smelter, a refinery, and two cobalt recovery plants and two sulphuric acid plants at Chambishi and Nkana. In 1997-98, the Nkana Division mined 2.69 Mt of copper sulfide ore grading 1.51% copper and 0.10% cobalt; 40% of production coming from the Mindola Shaft. Production of 121,943 t of copper concentrates with a copper recovery rate of 95.6% and 99,467 t of cobalt concentrates with a cobalt recovery rate of 62.49% was down by 11% and 22% respectively, from that of 1996-97. At the Nkana smelter, which encountered high maintenance problems during the year, the output of 99,783 t was down by 19% from that of 1996-97.

The Luanshya Division operated the Luanshya and the cobalt-rich Baluba underground mines, two mills, a smelter that was reopened in January 1997, and the Ndola precious metals refinery. The copper refinery at Ndola remained closed in 1997-98. Between April 1, 1997 and the sale of the Luanshya Division to the Binani Group on October 1, 1997, ZCCM reported the following production levels: the Luanshya Division mined 603,000 t of ore grading 1.54% copper at the Luanshya Mine, 721,000 t of ore grading 1.82% copper and 0.14% cobalt from the Baluba Mine, and 204,590 t of ore grading 1.91% copper from the Baluba East Mine; mill production included 48,124 t of copper concentrates with a copper recovery rate of 90.34% at the Luanshya mill and 31,177 t of copper concentrates with a copper recovery rate of 93.09% and 36,111 t of cobalt concentrates with a cobalt recovery rate of 6.67% from the Baluba mill; and the Luanshya smelter produced 18,447 t of blister copper.

ZCCM's Konkola Division operated a mill and the Konkola underground mine. Konkola, one of the wettest mines in the world, pumped out 287,000 cubic meters of water per day and was a major input to the local water supply. In 1997-98, Konkola mined 1.94 Mt of copper ore grading 2.90% copper compared with 2.12 Mt grading 2.66% copper in 1996-97. Copper concentrate production of 119,616 t, with a copper recovery rate of 88.22%, remained roughly level with 1996-97.

First Quantum Minerals completed construction of the $30 million Bwana Mkubwa Copper Project (BMCP) ahead of schedule in December 1997. BMCP, 100% owned by First Quantum, is located 5 kilometers (km) from the regional mining center of Ndola. The leach-SX-EW treatment plant was designed to recover and treat copper from the No. 4 Tailings Dam at the old Bwana Mkubwa Mine. By March 1998 the plant is expected to be at full production, producing 10,000 t/yr of cathode copper and 110,000 t/yr of sulfuric acid, of which 70,000 t will be available for local sales. The plant was designed to provide processing capacity for any additional ore proven up within the mining license and the Koloko Hills prospecting license acquired in 1997. The mine site was first worked for copper around A.D. 700 and more recently from 1930 to 1931 and 1971 to1984. Drill testing of only the No. 4 oxide tailings dump defined a reserve of 8.4 Mt grading 0.73% copper. In addition, ZCCM reported 230,000 t grading 2.54% copper in the west wall of the pit. In a 1990 report Watts, Griffiths and McOuat (WGM) identified 900,000 t grading 2.85% copper in the pit floor and an additional resource of 3 Mt grading 1.4% copper in the immediate vicinity of the pit (First Quantum Minerals Ltd., June 25, 1998, The Bwana Mkubwa copper mine: accessed November 9, 1998, at URL http://www.first-quantum.com/property_mining _bwana.html).

Cyprus Amax., which acquired an 80% interest in the Kanshansi copper mine and deposit from ZCCM in 1997, committed to spend $5 million during 1997 and 1998 to evaluate the resource potential of the deposit beyond the 24 Mt of 3% copper previously identified by ZCCM. Depending on the results of the first phase, Cyprus Amax will make an additional payment of $10 million to ZCCM and commit $15 million to further drilling and a feasibility study. Upon determination that a mining project is feasible, a final payment of an additional $15 million will be made to ZCCM. Proximity of Kansanshi to the Congo-Kinshasa border and the

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civil war there remained a concern of the company. Cyprus Amax closed the high cost Kansanshi Mine in January 1998, to concentrate capital resources on the regional exploration of the Kansanshi area resource base.

In May 1997, Caledonia also signed a joint venture agreement with Cyprus Amax allowing the latter to earn a 75% interest in Caledonia's Kadola copper prospect. During 1996 exploration, Caledonia had outlined an inferred mineral resource of 74 Mt grading 0.95% copper at the Kadola West prospect (Caledonia Mining Corporation, 1996).

Gold.—Reunion Mining PLC of the United Kingdom poured the first gold at its Dunrobin gold mine, located 120 km west of Lusaka, in August 1997. It is the first privately owned mine to be developed in Zambia in 30 years. Production will be at the rate of 50 kilograms per month or 600 kilograms per year. Proven and probable reserves amount to 1.2 Mt grading 2.1 grams per ton in a semiconsolidated quartz-hematite gossan material overlying the old mine. Reserves were sufficient for 3 years of production. After heap leaching gold, will be recovered by standard carbon columns, elution, electrowinning, and smelting to produce doré bars suitable for export to a refinery in Zimbabwe (Reunion Mining PLC, 1997). The project was financed with a $4.5 million gold loan provided by N.M. Rothschild & Sons Limited, repayable in equal installments at 6, 12, 18, and 24 months after first production.

Iron and Steel.—A joint venture between Art Engineering of Zambia and United Steel Co. of Kenya announced plans to start trial production of a 20,000-t/yr steel rerolling mill at Ndola. Ziscosteel in Zimbabwe was identified as the likely source of billet for the plant. The joint venture also planned to build a ferrous scrap melting shop to process from 700 to 1,000 tons per month of ferrous scrap currently exported to South Africa for processing (Metal Bulletin, 1997a).

Other Metal Exploration.—In addition to the previously described activity a number of companies had active exploration programs underway in Zambia in 1997. These included American Mineral Fields Inc. of the United States, which was exploring for an extension into Zambia of the Kipushi copper-zinc mine in Congo (Kinshasa) through its 100% owned subsidiary, ZamGold Ltd.; Billiton Plc. of the United Kingdom, which was exploring for carbonate-hosted lead-zinc mineralization in the Kabwe area and for copper-gold targets in the Kafue Flats, the Kasempa, and the Mumbwa areas; Casmyn Corp. of the United States which was active on the Luswishi copper property; the Zambezi Joint Venture, comprised of Anglo American Prospecting Services (Pty.) Ltd. (70%) and Equinox Resources N.L. of Australia (30%), was conducting field and aeromagnetic studies on nine copper-gold prospecting licences within the Copperbelt; First Quantum, which was working on the Karibarembi copper-gold, the Nchonho gold-bismuth, and the Lutembwe gold properties; and Tan Range Exploration Corp. of Canada which was conducting further geochemical sampling and diamond drilling on a highly altered shear zone on its Chetina gold property, north of Lusaka.

Industrial Minerals

Cement.—Chilanga Cement maintained plants at Lusaka and Ndola on the Copperbelt having capacities rated at 200,000 and 290,000 t/yr, respectively. Chilanga also had the capacity to produce 441,000 t/yr of clinker. In 1997, 384,000 t of cement was produced, an increase of 10% from that of 1996. Total cement sales of 389,000 t were valued at $26.3 million. Chilanga sold more than 10% of its annual production to ZCCM and maintained strong export markets to Malawi and other neighboring countries. Between 1995 and 1997, Chilanga cement exports increased from 24% to 38% of total cement sales, partly in response to reduced consumption at ZCCM. Chilanga was exploring for additional limestone reserves in anticipation of increasing capacity in the future to respond to an expected increased cement consumption by the newly privatized copper sector (Pangaea/EMI Securities Limited, April 1998, Chilanga Cement PLC, accessed September 4, 1998 at URL http://www.pangaeapartners.com/chilanga.htm).

Gemstones.—The Ministry of Mines and Mineral Development continued its program to develop production of gemstones other than diamonds found in many parts of the country. Training and other assistance were being provided to small local mine operators. The Ministry believed the sector should also be attractive to foreign investment in mining, processing, and marketing. Emeralds, mostly produced about 200 km north of Lusaka (Ndola rural area), were estimated to compose about 80% of total gemstone production in value. However, amethyst output, mostly from a location about 300 km south-southwest of Lusaka (Kalomo area), was the largest by volume. Additionally, aquamarine and tourmaline, mostly from a location about 600 km northeast of Lusaka (Lundazi area), as well as garnet, agate, and other gemstones at a number of locations were produced. Of the 30 to 40 registered gemstone operations in the country, two were large, mechanized mines that were joint ventures with the Government. From 200 to several thousand small unregistered mining operations were estimated to be operational. [A description of the Zambian gemstone industry and resources is available on the Internet at URL http://www.africa-insites.com/zambia/info/General/gemstones.htm].

During 1997, BHP signed an agreement with Caledonia to fund 100% of the Mulongo Plains diamond project through the completion of a feasibility study to earn a 75% interest in the project. BHP exercised this option following completion of a reconnaissance regional stream and sediment sampling program in 1997. Under the terms of the agreement BHP will cover up to $75 million of Caledonia's share of any future construction costs (Caledonia Mining Corporation, 1998, Mulongo Plains—Diamond properties—activity report, 1997 annual report, accessed December 12, 1998 at URL http://www.caledoniamining.com/html/activity_report.htm).

Vantage Enterprises Corp. of Canada was awarded a gemstone license to develop a new tourmaline mine at Kalunga Wbeba in the Eastern Province. The Kalunga Wbeba deposit contains gem-quality pink, green, colorless, and watermelon tourmaline. Production of rough tourmaline will be sent to a Vantage subsidiary in India for cutting and polishing. Within Zambia, the company also operated the Krystal amethyst mine, a Lusaka gemstone processing and grading facility, the Berylex emerald exploration project. The Krystal Mine produced around 380 tons of amethyst rough in 1997 (Vantage Enterprises Corp., July 2, 1997, Krystal Mine, accessed June 4, 1998 at URL http://www.vantage-gems.com).

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Zarus Drilling, a 50-50 joint venture between Mwanamuto Investments of Zambia and two Russian companies, Ural Gold and Platinum Co. and Volgageologia, was also exploring for emeralds.

Lime.—Ndola Lime Company Ltd., a fully owned subsidiary of ZCCM and the country's only producer of quicklime, crushed limestone, hydrated (slaked) lime and agricultural lime was a candidate for privatization. Its largest domestic clients were ZCCM, Zambia Sugar, and water treatment plants. It also sells to the construction, manufacturing and agriculture sectors and exports approximately 3% of its production to Burundi, Congo (Kinshasa), Malawi, Namibia, South Africa, Tanzania, and Zimbabwe. The company, which is located in Ndola, has been operating since 1960 and it has limestone reserves of at least 18 Mt, of which 4 Mt are proven and 14 Mt are probable; there are an additional 60 to 90 Mt of resources. Production of quicklime is about 200,000 t/yr, although rated capacity is more than 300,000 t/yr. Production is tied to ZCCM's level of copper production. In 1995, Ndola Lime's mining licence was renewed for 25 years. The processing plant consisted of crushing and screening equipment installed in 1993. Limestone was burned in a rotary kiln installed in 1973 and an annular shaft kiln installed in 1986. The lime hydration plant dated to 1961. The combined rated capacity of the kilns is 1,000 t/d of limestone (Zambia Investment Centre, 1998, Privatization—Ndola Lime Company Ltd. Accessed January 5, 1999 at URL http://www.africa-insites.com/zambia/business/investments/privatization.htm).

Mineral Fuels

In January, heavy flooding caused major damage to the Maamba Collieries leading to its closure. ZCCM coal needs were then imported from the Wankie Colliery in Zimbabwe. The new owner of Maamba, Benicon, was committed to rehabilitating the operation, which is located 350 km south of Lusaka in the Kanzie and Izuma basins. Estimates of remaining coal reserves at Maamba as of January 1996 were 78.2 Mt of which 60.2 Mt were proven and 18 Mt probable. The two open pit mines have the capacity to produce between 600,000 and 800,000 t/yr of coal (Zambia Privatisation Agency, 1996, Mine capacity and reserves—Maamba Collieries Limited, accessed December 4, 1997, at URL http://www. zamnet.zm/zambus/zpa/mcladv.htm).

Reserves

Resources of those minerals in production generally were extensive, including separate, unexploited deposits in various areas, and occurrences of other potentially valuable minerals were widespread geographically. ZCCM has provided a comprehensive listing of its copper and cobalt reserves and resources in its 1997 annual report (*See Tables 2 and 3*). Gold ore resources were being studied by several groups but were yet to be fully defined with the exception of the previously discussed Dunrobin deposit. Many occurrences were located throughout the country, some around and to the east of Lusaka. Lead-zinc reserves at former operations were limited, but additional resources were known at several locations. Remaining resources projected at the closed Kabwe Mine were reported to be 59 Mt at 3.5% zinc and 1.5% lead, mostly of low-grade disseminated ores. Nickel resources at the Munali sulfide deposit were put at 10.4 Mt at 1.1% nickel with minor copper, gold, silver, and platinum-group-metal content. The Kalumbila deposit had resources estimated to be 8 Mt at 0.55% nickel. Neither deposit was fully defined, and extensions were to be explored. Additional resources have been projected at other sites. A large variety of other metallic minerals deposits also were known, but needed further exploration. Most work in the past apparently was on iron, molybdenum, and tin-tantalum. Of the many industrial mineral resources that were being exploited or studied by commercial groups, gemstones were of the most value, but others included clays for brick and tile and for refractories; fluorspar; granite-syenite dimension stone, gypsum; limestone for cement and lime manufacture; magnetite; marble; phyllite, probably for cement manufacture; silica, mostly for glassmaking; and talc. Only low grade phosphate resources were known, one of which was a carbonatite in the northeast. Petroleum resources remained conjectural; no known activity has taken place since some surveys along the Zambesi River east from Victoria Falls to Mozambique were completed in 1990.

Infrastructure

As a landlocked country, Zambia was dependent on truck and rail transport to sustain most of its economy. The truck road and railway networks within the country and externally were reasonably adequate for access to ocean and lake ports for international trade. Major highways generally paralleled the rail lines. About 20% of the main roads were paved, and about 20% were gravel or stabilized earth. The principal rail routes were northeast to and from the port of Dar es Salaam, nearly 2,000 km from Ndola in the Copperbelt, mostly on the Tanzania Zambia Railways Authority (Tazara) line; and south through Zimbabwe to and from South African ports, more than 2,500 km from Ndola, using the Zambia Railways Ltd. line in Zambia. The roughly 2,000-km rail link southeast to the port of Beira, through Zimbabwe, became generally available after a long hiatus owing to civil war in the port country. The more-than-2,200-km rail link north into Congo (Kinshasa) and west to the port of Benguela (Lobito), Angola, has remained unavailable during the 18-year civil war in Angola. A crude oil pipeline ran from Dar es Salaam about 1,700 km southeast to a refinery in Ndola. It was owned and operated by Tazama Pipelines Ltd., a joint venture of the Zambian and the Tanzanian Governments.

The sources of electric power capacity were hydroelectric (70%), oil (20%), and coal plants (10%). Although nearly self sufficient in hydroelectric power, the facilities have suffered from deferred maintenance. With help from the World Bank and other western donors in 1997, Zambia announced a $200 million project to rehabilitate all the power stations in the country. The project will include power stations at Kafue Gorge, Kariba Dam, Kariba North Bank, Victoria Falls, and transmission and distribution systems in Kitwe, Lusaka, and Ndola. The Government was also seeking foreign investment to own, build, and operate a new-600 MW Lower Kafue Gorge hydroelectric plant to tap the remaining power potential from the Kafue Gorge for future domestic and export market needs. The energy source for mobile equipment continued to be imported petroleum, mostly refined products, although a significant amount of imported crude petroleum was refined in the state-owned facility at Ndola. The household energy source was wood, which continued to be the country's largest single source of energy.

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Outlook

The future revitalization of the minerals industry of Zambia, especially of the copper sector, rests on the successful completion of its current privatization plan. Government efforts to put in place a favorable investment climate for new mining projects began to pay off in 1997, with most of the Privatization Packages offered for sale being taken up by foreign investors. The country, however, faced several internal and external hurdles to development, including high transportation costs, the threat that high HIV/AIDS rates in the region posed on maintaining a skilled labor force, depressed world commodity prices, and the renewal of civil wars in neighboring Angola and Congo-Kinshasa, adding to the political risk of financing new projects (UNAIDS, December 1998 report by Joint United Nations Program on HIV/AIDS, accessed December 20, 1998 at URL http://www.who.int/emc-hiv). Stabilization of all or some of these factors will be needed for the country to benefit fully from the expected infusion of new foreign investment and technology. Copper-cobalt output in the short term was likely to continue its decline owing to restructuring and operating problems, but improved efficiency and new foreign investment should bring a turnaround. The gemstone sector also has the potential to generate a larger value-added industry in Zambia. A renewed exploration interest in diamond and zinc resources was also evident.

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Major Publication

Investment Opportunities in the Mineral Sector of Zambia, Ministry of Mines and Mineral Development, Lusaka, Zambia.

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TABLE 1
ZAMBIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
METALS						
Beryllium: beryl	kilograms	178	857	1,000 e/	1,000 e/	800 e/
Cobalt: 2/						
Mine output, Co content		4,840	3,600	5,908	6,959 r/	6,043
Metal, Co content		4,211	2,639 r/	2,934 r/	4,611 r/	4,386
Copper: 2/ 3/						
Mine output, Cu content:						
By concentration or cementation		344,200	289,800	254,000 r/	276,000 r/	288,900
Leaching (electrowon)		84,100	83,400	62,000 r/	58,000 r/	64,000
Total		428,200	373,200	316,000 r/	334,000 r/	352,900
Metal:						
Smelter, primary:						
Electrowon (low grade)		62,400	25,342	65,400 r/	73,900 r/	70,400 e/
Other		305,100	241,036	234,500 r/	250,300 r/	245,300
Total		367,600	266,378	299,900 r/	324,100 r/	315,800
Refinery, primary:						
Electrowon		48,800	67,255	62,000 r/	58,000 r/	66,600
Other		363,200	284,784	266,000 r/	276,000 r/	271,800
Total		412,100	352,039	328,000 r/	334,000 r/	338,400
Gold: 2/	kilograms	235	124 r/	91	119	290 e/
Lead: 2/						
Mine output, Pb content		7,027	--	--	--	--
Metal, refined		2,000	--	--	--	--
Selenium, refined, gross weight 2/	kilograms	26,700	21,115	18,550	20,016 r/	15,161
Silver: 2/	do.	18,000	10,002	8,676	9,410 r/	6,684
Zinc: 2/						
Mine output, Zn content of ore milled		16,704	--	--	--	--
Metal, refined, primary		3,450	--	--	--	--
INDUSTRIAL MINERALS						
Cement, hydraulic e/		310,000	280,000 4/	312,000 4/ r/	348,000 4/ r/	384,000 4/
Clays:						
Brick e/		3,000	3,000	3,000	3,000	3,000
Building, not further specified e/		2,000	27,000 4/	30,000	30,000	30,000
China and ball e/		200	200	200	200	200
Gemstones: e/						
Amethyst	kilograms	398,000 4/	366,000 4/	350,000	350,000	380,000
Aquamarine	do.	74 4/	21 4/	200	200	200
Emerald	do.	138 4/	160 4/	180	180	180
Gypsum e/		14,000	11,200	11,000	11,000	11,000
Lime, calcined e/	thousand tons	206 4/	195 4/	200	200	200
Limestone (cement and lime) e/	do.	770	710	800	800	800
Magnetite, gross weight e/		1,250 4/	1,070 4/	1,000	1,000	1,000
Nitrogen: N content of ammonia e/		5,000	3,000	3,000	3,000	3,000
Sand and gravel, construction e/	thousand tons	500	117 4/	200	200	200
Stone, construction:						
Limestone, crushed aggregate e/	do.	632 4/	668 4/	700	700	700
Other e/	do.	700	700	700	700	700
Sulfur: 2/						
Pyrite concentrate:						
Gross weight		80,800	55,572	69,228	78,971 r/	69,059
S content (42%) e/		33,400	22,062 4/	28,314 4/	33,200 r/	29,005 e/
Sulfuric acid: 5/						
Gross weight		218,175 r/	224,838 r/	218,252 r/	206,572 r/	178,482
S content (32.6%)		71,125 r/	73,300 r/	71,150	67,340 r/	58,185 e/
Total, S content		104,525 r/	95,362 r/	99,464 r/	100,540 r/	87,190 e/
Talc e/		62 4/	76 5/	80	80	80
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous e/	thousand tons	301 4/	163 5/	141	100	10
Petroleum, refinery products e/ 2/	thousand 42-gallon barrels	5,300	5,300	5,000	5,000	5,000

e/ Estimated. r/ Revised.

1/ Table includes data available through December 15, 1998.

2/ Data are for year beginning April 1 of year stated.

3/ Terms are used as defined by the International Copper Study Group.

4/ Reported figure.

5/ From Nkana and Chambishi acid recovery plants.

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TABLE 3
ZAMBIA: ZAMBIA CONSOLIDATED COPPER MINES LIMITED'S
MINERAL RESOURCES BY MINE, AS OF MARCH 31, 1997

(Million metric tons)

Mine, by type of development	Gross weight	Copper percent TCu	Cobalt percent
Nchanga:			
Underground	41	3.0	--
Open pits	53	3.2	--
Unclassified (OP or U/G)	39	2.6	--
Refractory ore (CRO)	180	1.2	--
Tailings dumps (TD 2, 3, 4)	104	0.8	--
Total	417	1.5	--
Konkola:			
Kirila Bombwe	297	3.8	0.07
Konkola	30	2.5	--
Saddle Lode / Konkola North	50	2.6	0.09
Fitwaola	3	3.5	--
Konkola South	5	2.0	--
Total	385	3.5	XX
Mufulira:			
Orebody extensions	41	3.1	--
Oxide mineralization--Mufulira East	4	2.6	--
Mufulira West	17	1.5	--
Total	62	2.6	--
Nkana:			
Extensions	118	2.4	0.12
Oxide caps	11	3.1	--
Nkana slag dump	20	1.1	0.15
Total	149	2.3	XX
Chibuluma:			
Chibuluma--West	2	2.5	0.12
Chibuluma--South	9	3.9	--
Total	11	3.6	XX
Chambishi:			
Chambishi--Main	45	2.6	--
Chambishi--West	46	2.2	--
Chambishi--Southeast	45	2.4	--
Total	136	2.4	--
Luanshya:			
Extensions	24	2.4	--
Mashiba	4	2.5	--
Oxide mineralization	8	2.6	--
Slag dump	9	0.7	0.40
Total	45	2.1	XX
Baluba:			
Extensions	2	2.1	0.15
Oxide mineralization	23	2.3	--
Total	26 1/	2.3	XX
Grand total	1,231 1/	2.4 2/	XX

XX Not applicable.
1/ May not add to totals shown because of independent rounding.
2/ Weighted average.

Notes--Mineral resources are defined as those materials which have been examined in sufficient detail to establish their mode of occurrence, size, and essential qualities and include reclamation material already mined or treated, for which there is a reasonable expectation of future exploration. Before such mineral resources can be transferred to the ore reserve category, investigation into the feasibility of economic exploration must be and additional investments incurred. ZCCM's resources are quoted as in situ grades and tonnages and are not factored for dilution and/or mineralization left in the ground due to unfortunate shapes, attitudes, or as pillars.

Source: Zambia Consolidated Copper Mines Limited, 1997 company annual report, p. 58.

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THE MINERAL INDUSTRY OF

ZIMBABWE

By Philip M. Mobbs

Zimbabwe's mineral industry was diverse, with a nucleus of asbestos, coal, chromite, copper, diamond, gold, granite, and nickel operations. Zimbabwe was a major contributor to the world supply of chrysotile asbestos, ferrochromium, and lithium minerals, and its mineral industry accounted for about 8% of the nation's $9 billion gross domestic product (Financial Gazette, December 11, 1997, Bleak future for mining industry, accessed March 19, 1998 at URL http://www.africaonline.co.zw/fingaz/stage/archive/971212/companies25583.html). Gold again was the country's leading mineral sector, but gold output stagnated at 24 metric tons (t); this was the first time in several years that production did not increase. Mineral exports accounted for about 45% of Zimbabwe's foreign currency earnings (Reserve Bank of Zimbabwe, April 3, 1998, Quarterly economics and statistical review, accessed April 10, 1998 at URL http://www.bizafrica.com/zimbabwe/busbul/reports.html).

Most of the country's mineral companies were export-oriented and subject to world market fluctuations. In 1997, the industry was battered by declining international prices for base and precious metals, higher labor and power costs, prohibitive interest rates, and spiraling inflation. The industry's local income, however, was enhanced by the November 14 collapse of the Zimbabwe dollar against international currencies, which temporarily offset these economically adverse factors. At yearend, Zimbabwe's mining companies were adopting survival strategies at the expense of development and exploration. Operations were scaling down to cut costs and to remain economically viable.

All mining activities came under the Mines and Minerals Act (Chapter 165) (1961), its amendments, and associated regulations. All mineral rights were vested in the state through the President of Zimbabwe. Investment projects were sanctioned by the Zimbabwe Investment Center. The Gold Trade Act gave the Reserve Bank of Zimbabwe a monopoly on purchasing and exporting all gold produced in Zimbabwe. The Government's Minerals Marketing Corp. Zimbabwe handled most other mineral exports. In response to the collapse of the Zimbabwe dollar, the Ministry of Finance closed all corporate foreign currency accounts on November 18 (Chamber of Mines Journal, 1998). Companies were forced to use the devalued local currency to secure foreign exchange to pay for imported equipment and supplies.

During 1997, the Ministry of Mines and the Ministry of Environment and Tourism were merged to form the Ministry of Mining, Environment, and Tourism. The state-owned mining company, Zimbabwe Mining Development Corp. (ZMDC) had an interest in a number of mining operations, and the Government's Industrial Development Corp. of Zimbabwe Ltd. had several subsidiary companies operating in the industrial mineral sector. Partial privatization of both companies was underway.

Approximately 45,000 people, or nearly 3% of the formal national labor force, were employed in medium- and large-scale mining operations. At the beginning of the year, African Associated Mines (Pvt.) Ltd. alone accounted for about 7,200 of the mining employees. An estimated 10,000 people worked the nation's smaller mines, and between 100,000 and 300,000 people were estimated to be involved intermittently in informal gold panning or reworking abandoned mines (Michael Hartnack, December 10, 1997, Business Day, Hard-hit Zimbabwe mines sack 2 000, accessed June 28, 1998, at URL http://www.bday.co.za/cgi-bin/post-query.perl; Michael Hartnack, May 29, 1998, Business Day, Zimbabwe mines yoked by costly bureaucracy, accessed June 11, 1998, at URL http://www.bday.co.za/98/0529/world/w24.htm). Because of the adverse economic conditions, nearly 3,000 of Zimbabwe's miners were fired during 1997 (Platt's Metals Week, 1998).

Zimbabwe had a significant local mining industry. More than 500 gold mining operations were registered, many of which were small scale (S.T. Mombeshora, Minister of Mines of Zimbabwe, unpub. data, 1997). Multinationals, such as Anglo American Corp. Zimbabwe Ltd., Falcon Gold Zimbabwe Ltd. (Falgold), Lonrho Zimbabwe Ltd., and Rio Tinto Zimbabwe Ltd. (RTZ), historically have dominated the nation's mining industry. A number of African, American, Australian, Canadian, and European mining companies also were exploring for diamond and gold.

Despite the Government's current policy of partial divestment of its interests in state-owned companies, it was concurrently pursuing an indigenization policy to increase black Zimbabwean's equity interest in multinational mining operations. A memorandum of understanding was signed in August allowing the Government to purchase shares in Bindura Nickel Corp. Ltd. from Anglo American Corp. Zimbabwe Ltd. In December, the Government's investment company, Africa Resources Investments (Pvt.) Ltd., secured 20% of Bindura for eventual resale to local black investors. The Government strongly suggested that Zimasco Consolidated Enterprises Ltd., Zimbabwe Mining and Smelting Co. (Pvt.) Ltd.'s (Zimasco) Mauritius-registered holding company, transfer 50% of its interest in Zimasco to the Government for subsequent resale. The Government's negotiations were upset when Nyika Investments, a local black-owned company acquired 27% equity interest in Zimasco (Sguazzin, 1997b). The Government complained of the sale's lack of transparency and subsequently threatened to expropriate Zimasco (Hawkins, 1997). The issue was under negotiation through yearend. Lonrho also was notified of the Government's intent to foster local equity interest in the company's Zimbabwean mining operations.

Falconbridge Exploration Zimbabwe (Pvt.) Ltd. and NAR

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Resources Ltd. of Canada began exploring the Maramba massive sulfide prospect 125 kilometers (km) northeast of Harare and a tungsten prospect 140 km northeast of Harare near the former Kakonde tungsten mine.

Zimasco and Zimbabwe Alloys Ltd. (Zimalloys) suffered from declining international ferrochrome prices and increasing operational expenses (Financial Gazette, March 26, 1998, Low prices hit Zim Alloys hard, accessed March 27, 1998 at URL http://www.africaonline.co.zw/fingaz/stage/archive/980326/companies7086.html). Zimalloys completed modifications of the ferroalloy plant in July. Economic constraints, however, forced Zimalloys to suspend mining at the Great Dyke II and the Inyala chromite mines in November and to cease other operations in December (Metal Bulletin, 1997, Financial Gazette, December 11, 1997, Bleak future for mining industry, accessed March 19, 1998, at URL http://www.africaonline.co.zw/fingaz/stage/archive/971212/companies25583.html). Despite the difficulties encountered by Zimasco and Zimalloys, construction of a 20,000-metric-ton-per-year (t/yr) capacity high-carbon ferrochrome plant at Eiffel Flats was proposed by Maranatha Holdings Ltd. of Zimbabwe.

The Government assisted with a $21 million loan to rehabilitate operations at Mhangura Copper Mines Ltd. and Lomagundi Smelting and Mining (Pvt.) Ltd., thus saving 2,200 jobs. Munyati Mining Co. Ltd., the copper-oxide-leach operations company owned by Reunion Mining plc of the United Kingdom and ZMDC, completed a study of the Sanyati heap-leach chemistry and modified ore-treatment procedures. Munyati continued to have sulfuric acid leachate supply problems.

Although the mines of Ashanti Goldfields Co. Ltd. of Ghana, Falgold, Lonrho, and RTZ dominated the gold sector, the numerous medium-and small-scale producers contributed about 10% to the nation's formal gold production and alluvial gold panning was Zimbabwe's rural alternative to subsistence farming. The Mining (Alluvial Gold) (Public Streams) Regulations (1991) authorized selective alluvial gold mining, but extensive riverbank erosion and stream siltation resulted from rampant unauthorized mining activity. Up to 2 t/yr of gold were estimated to be smuggled out of the country from illegal mining operations (Michael Hartnack, May 29, 1998, Business Day, Zimbabwe mines yoked by costly bureaucracy, accessed June 11, 1998 at URL http://www.bday.co.za/98/0529/world/d24.htm).

Ashanti produced a record 3,311 kilograms (kg) (106,447 troy ounces) at the Freda Rebecca Mine in 1997 from 738,000 t of ore produced from the underground workings grading 3.07 grams per ton (g/t) of gold and 374,000 t of ore from the Freda open-pit grading 4.1 g/t of gold. Ashanti was developing the Freda underground mine to replace the open pit. Beringer Gold Corp. of Canada (formerly Guyana Gold) divested its interest in the Sabi gold mine. Casmyn Corp. of the United States was processing tailings dump material and ore from the open-pit Turk Mine. The ownership of the Connemara Joint Venture changed in December when First Quantum Minerals Ltd. of Canada acquitted International Ballater Resources Inc. of Australia and its subsidiary Sumtech (Pvt.) Ltd. Ore throughput at Connemara had been tripled to 750,000 t/yr during 1997.

Falgold, which was restructuring its Zimbabwe operations, cut back on mining operations and reduced staffing at the Dalny and the Venice Mines and in December agreed to sell the Globe & Phoenix, the Bell-Riverlea, and the Dalling Mines to Delta Gold NL of Australia. At the Blanket Mine, Kinross Gold Corp. of Canada changed the carbon-in-leach process to an oxygen accelerated leaching system. Kinross also sold its 250-kilogram per year (kg/yr) Golden Kopje Mine.

Lonrho's subsidiaries, Independence Mining (Pvt.) Ltd. and Corsyn Consolidated Mines (Pvt.) Ltd., laid off workers as part of the restructuring of the group's mining activities. The companies undertook a comprehensive operational review and reduced operations at all nine mines. RTZ closed the Brompton Mine in August. After this closure, feed for the mill at the Patchway Mine was augmented with material from the surface stockpile.

Oliver Gold Corp. of Canada increased its interest in Maple Leaf Mining (Pvt.) Ltd. of Zimbabwe, operator of the C and the Camp Mines, to 100%. Trillion Resources Ltd. of Canada and ZMDC completed the realignment and deepening of the Stump Incline shaft at the Jena Mine. Mining and milling operations at the Indarama Mine were expanded. Trillion subsequently acquired the remaining 80% interest in the Indarama Mine and rename the 450-kg/yr operation the Ndarama Mine.

In September, African Gold plc of the United Kingdom started gold production from the Beehive Mine, and Anglo American Corp. Zimbabwe Ltd. began operations at the Bubi Mine. Delta Gold was developing gold mines on the Chaka property near Kwekwe, where the mill was under construction, and on the Eureka prospect near Guruve, following a positive feasibility study. The Chaka Mine was expected to be onstream in 1998, followed by the Eureka Mine in 1999.

In February 1997, Cambrian Resources NL of Australia obtained an option to acquire 55% interest in an exclusive prospecting order (EPO) near the former Giant Mine from Canyon Resources Africa Ltd. In September, Prospecting Ventures Ltd., an exploration subsidiary of Anglo American Corp. Zimbabwe, bought into the project. Reunion started a feasibility study at the Maligreen gold prospect. Reunion and Prospecting Ventures were drilling on the Magondi project and Rift Resources Ltd. of Canada and Reunion were working on the Silobena Project.

Also exploring for gold in Zimbabwe were Afrimin SA (Pty.) Ltd. of South Africa, a subsidiary of Afrimin Holdings Ltd. of the British Virgin Islands and Indomin Resources Ltd.; Ashanti; Barrock Mine (Pvt.) Ltd., a subsidiary of Mandorin Goldfields Inc. of Canada; Casmyn; Clear Creek Resources Ltd. of Canada; Commonwealth Gold Ltd. of the United Kingdom, a subsidiary of Amalia Gold Mining & Exploration Co. of South Africa; Forbes and Thompson Ltd. of Zimbabwe; Inmet Mining Corp. and Altavista Mines Inc. of Canada; Kinvara Ventures Inc. of Canada; Masasa Mines (Pvt.) Ltd. of Zimbabwe; North Rand NL of Australia; RTZ; Oliver Gold; Royalstar Resources Ltd. of Canada; Trillion; and Westley Mines International Inc. of Canada.

The Government initiated a partial privatization of its 89% interest in Zimbabwe Iron and Steel Co. (Pvt.) Ltd. (Zisco) at the beginning of 1997; in May, however, it declared the submitted bids to be unsatisfactory (Sguazzin, 1997a). The long-awaited rehabilitation and relining of Zisco's No. 4 blast furnace was begun by China's Shougang International in June. In August, the

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Government announced that Ferrostaal AG of Germany had agreed to rehabilitate Zisco's casting plant. The contract for the renovation of Zisco's billet and rod mills was under negotiation.

Zisco commissioned a 1.8-million metric-ton-per-year sinter plant in Redcliff. Iron ore was delivered to the plant from the Ripple Creek iron mine on a 15.6-km curved conveyor. The conveyor was rated at a capacity of 500 metric tons per hour (t/hr). At midyear, JCI Ltd. announced that Campanhia Vale de Rio Doce of Brazil would supply iron ore for JCI's iron project at Beira, Mozambique, instead of Buchwa Iron Mining Co. of Zimbabwe. Steelmakers Ltd. of Kenya built a 18,000-t/yr rolling mill near Zisco's plant. Steelmakers also started construction of a 45,000-t/yr melting shop for alloy and stainless steel production.

RTZ's nickel toll refining operations at the Empress Refinery continued to be constrained by limited nickel matte from Botswana. A report prepared for the Government's acquisition of Bindura Nickel Corp. proposed closing Bindura's Madziwa and Epoch Mines and developing the Hunters Road nickel property (Financial Gazette, September 18, 1997, Bindura Nickel threatened with collapse?, accessed September 24, 1997, at URL http://www.africaonline.com/fingaz/national1.html).

In the platinum sector, BHP Minerals Zimbabwe, a subsidiary of Broken Hill Proprietary Co. Ltd. of Australia and Delta Gold opened the base metals refinery at the Hartley platinum complex in June. BHP shipped the first platinum-group metals concentrate to Johnson Matthey in the United Kingdom in October. Operations had been delayed by heavy rains early in the year and problems with faulted ground in the South portal. The mine's staff of 2,800 was producing 60,000 metric tons per month of ore. Delta Gold retained a 9.9% interest in net cash flow of the Hartley Mine in lieu of paying a lump-sum 33% share of the about $289 million capital expenditure for the development of the Hartley project to BHP (Delta Gold NL, 1997). Anglo American Corp. completed a prefeasibility study on the Unki platinum prospect, and JCI began a feasibility study Delta Gold's Ngezi platinum prospect.

Asbestos production in Zimbabwe was adversely affected by the economic crisis in Asia, a major market, and the associated reduced asbestos demand (Financial Gazette, March 19, 1998, Changing market demands force African Associated Mines reduce asbestos output, accessed March 19, 1998, at URL http://www.africaonline.co.zw/fingaz/stage/archive/980319/national1042.html). African Associated Mines was forced to lay off nearly 1,000 employees during 1997.

Unicem Manufacturing, a subsidiary of Portland Holdings Ltd., commissioned an 100-t/hr cement mill in Bulawayo in November 1997. At the Colleen Bawn works, about 120 km southeast of Bulawayo, Unicem increased limestone production and was upgrading the cement kiln as part of the company's $36 million expansion program. Cement production capacity was to be increased from 660,000 to 1 million t/yr. Harare-based Circle Cement Ltd. began a 3-year, $69 million expansion to increase production to 750,000 t/yr. Production was reduced as a result of heavy rains at the beginning of 1997 and the electricity price hike near the end of the year.

In May 1997, partners in the River Ranch Diamond Mine, Redaurum Ltd. of Canada and Auridam Consolidated NL of Australia, restructured their joint venture. The operating company, Auridam Zimbabwe (Pty) Ltd., became River Ranch (Pvt.) Ltd. The company added a third 100-t/hr scrubbing unit in June. As prices for the diamond produced at River Ranch continued to fall through the year, Redaurum announced its intention to reorganize and divest its diamond properties (Redaurum Ltd., December 10, 1997, press release, accessed December 11, 1997, at URL http://biz.yahoo.com/bw/971210/redaurum_limited_1.html).

About 90% of the country was under EPO's for diamond. Companies exploring for diamond included Auridam, Kimberlite Searches Ltd. of Bulawayo, RTZ, and the Trillion-Nickelodeon Minerals Inc. joint venture. During 1997, Cratonic NL of Australia acquired the exploration interests of Delta Gold's diamond group, and Reunion terminated its diamond exploration program in Zimbabwe.

Zimbabwe Phosphate Industries' 16,000-t/yr phosphoric acid plant was subject to a $2.8 million upgrade to increase its annual capacity to 40,000 t. The Harare plant also began building a $1.8 million gypsum tailings dam to replace the old tailings dam that was filled in December 1997.

JCI completed a feasibility study for Wankie Collieries Co. Ltd. concerning the opening of a new coal mine to supply the future fuel demand of the Government's Zimbabwe Electricity Supply Authority's (ZESA) Hwange power station. In 1997, Wankie's coal production remained constrained by lack of local demand. Shagani Energy (Pvt.) Ltd. and Discovery Exploration (Pvt.) Ltd. were developing coal bed methane resources in Lupane.

Most of landlocked Zimbabwe's bulk commodities were moved by rail. All major cities and industrial centers were linked to Botswana, Mozambique, South Africa, and Zambia by the National Railways of Zimbabwe's 2,745 km of track. Petroleum products were piped through Mozambique via the Beira pipeline to Feruka, near Mutare, and then moved west via the Mutare-Harare pipeline or trucked on Zimbabwe's 85,784-km road network. Additional petroleum products were imported via railroad tanker cars through South Africa.

ZESA, which generated and supplied electric power to the country, had an installed electricity-generating capacity of 1,786 megawatts (MW). As a member of the southern African electrical power pool, Zimbabwe imported about 40% of power needs from the Democratic Republic of Congo, South Africa, and Zambia (Sidney Masamvy, November 20, 1997, Financial Gazette, YTL-ZESA Hwange deal collapses?, accessed March 19, 1998, at URL http://www.africaonline.co.zw/fingaz/stage/archive/971121/national11467.html). Power from the Cahora Bassa dam in Mozambique became available near yearend with the completion of a 420-kilovolt line connecting the Zimbabwe and the Mozambique electricity grids.

In August, ZESA began a $3.2 billion expansion program. The first of three proposed electricity rate increases became effective in October 1997 to fund the 15-year project, which included adding 660 MW of electricity-generating capacity to the Hwange thermal power station. ZESA and Yeoh Tiong Lay Power International Bhd. (YTL) of Malaysia were negotiating terms of the Hwange expansion. YTL was also negotiating a controversial deal to partially privatize the Hwange thermal power station.

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ZESA and National Power International of the United Kingdom completed the feasibility study for the proposed 1,320-MW capacity Gokwe North coal-fired plant near the inactive mine of Sengwa Colliery (Pvt.) Ltd., a subsidiary of RTZ. Also part of ZESA's expansion program was a proposed 1,600-MW hydroelectric plant at the Batoka Gorge, about 70 km downstream from Victoria Falls.

Asbestos, coal, ferroalloys, gold, and nickel were expected to remain the mainstays of the Zimbabwean economy through the turn of the century, and the significance of copper, diamond, granite, and PGM mining to the national economy was expected to increase. The continued high cost of domestic capital, potential negative international perception of governmental actions, costs associated with the widespread HIV infection of the workforce, and any continued depression of international metal prices could be detrimental to the industry (Financial Times, 1997; Nqobile Nyathi, April 30, 1998, Financial Gazette, Private sector lacks clear-cut AIDS policy, accessed May 1, 1998 at URL http://www.africaonline.co.zw/fingaz/stage/archive/980430/national147.html). The devaluation of the Zimbabwe dollar will manifest itself in increased costs of imports, including electric power, mineral fuels, and mining equipment and supplies. The Government was leery of the potential negative political and social repercussions if ZESA and the state-run National Oil Co. of Zimbabwe were allowed to pass on the full cost of increased expenses of imports (Financial Gazette, August 7, 1998, Petrol, diesel prices hiked by up to 20%, accessed August 7, 1998 at URL http://www.africaonline.co.zw/fingaz/stage/archive/980808/national21991.html). The investment regulations, the nation's well-developed and well-maintained infrastructure, new exploration techniques, and accessible mineral resources, however, were expected to encourage further local and foreign participation in the mineral industry.

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TABLE 1
ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Antimony, mine output, concentrate, Sb content		95	65	37	5	5
Beryllium, beryl concentrate, gross weight		23	-- r/ e	-- r/ e	-- r/ e	--
Chromium, chromite, gross weight	thousand tons	252	517	707	697	670
Cobalt: 2/						
Mine output, Co content e/		90	100	80	95	100
Metal (hydroxide)		113	126	109	106 r/ 3	132
Columbium and tantalum, tantalite concentrate, gross weight		48	7	1 e/	-- e/	--
Copper:						
Mine output, concentrate, Cu content e/	thousand tons	9	9	9	10	9
Metal:						
Smelter output, blister/anode, primary e/		8,200	10,000	8,000	7,600	4,000
Refinery output, refined/cathode, primary		8,187	9,350	6,875	10,900	8,800
Gold	kilograms	18,916	20,512	23,959	24,699	24,244 3/
Iron and steel:						
Mine output, iron ore:						
Gross weight	thousand tons	375	4	311	324	479
Fe content e/	do.	225	3	160	160	240
Metal:						
Pig iron e/	do.	211	100	209 3/	210	210
Steel, crude	do.	221	187	210	212	240
Ferroalloys:						
Ferrochromium	do.	124	183	254	243 r/ 3	235
Ferrosilicon chromium	do.	30	36	47	33 r/	41
Ferromanganese		2,151	--	--	--	--
Nickel:						
Mine output, concentrate, Ni content		12,769	13,836	11,721	11,561	12,000
Refinery output, refined metal		11,097	13,516	10,864	9,694	9,923 3/ 4/
Platinum-group metals:						
Palladium	kilograms	11	17	17 e/	120 e/	345
Platinum	do.	4	7	7 e/	100 e/	245
Selenium	do.	1,113	2,009	2,000 e/	2,000 e/	2,000
Silver	do.	12,004	10,942	15,640	9,982	5,923 3/
Tin:						
Mine output, Sn content e/		800	100	10	10 e/	10
Smelter output, metal		657	82	--	--	--
INDUSTRIAL MINERALS						
Asbestos	thousand tons	157	152	169	165	145
Barite		120	--	--	-- e/	--
Cement, hydraulic e/	thousand tons	1,000	1,070	905 r/	962 r/	965
Clays:						
Bentonite (montmorillonite)		113,470	169,097	169,823	185,953	186,000
Fire clay		9,257	13,997	12,743	14,479	14,000
Kaolin		90	462	57	--	--
Diamond	carats	43,850	173,588	204,416	437,266	421,307 3/
Emerald	kilograms	635	276	2,209	1,080	1,000
Feldspar		1,553	1,617	3,920	3,248	3,500
Graphite		7,142	7,890	11,381	7,691	12,779 3/
Kyanite		878	567	875	141	150
Lithium minerals, gross weight		18,064	25,279	33,498	30,929	49,833 3/
Magnesite		6,276	1,588	5,597	10,659	10,000
Mica		510	213	1,040	1,500	1,000
Nitrogen, N content of ammonia e/		70,000	70,000	70,000	70,000	70,000
Phosphate rock, marketable concentrate	thousand tons	153	151	154	123	125
Pigments, iron oxide		390	438	400	400 e/	400
Stone, sand and gravel:						
Granite		40,032	106,605	121,685	109,268	109,000
Limestone	thousand tons	1,036	1,658	1,499	1,425	1,500
Quartz 5/	do.	61	131	172	96	100

See footnotes at end of table.

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TABLE 1--Continued
ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
INDUSTRIAL MINERALS--Continued						
Sulfur						
Pyrite:						
Gross weight		72,588	71,026	70,706	59,831	48,101 3/
S content e/		32,000	31,000	31,000	26,000	21,000
Byproduct acid, metallurgical and coal process gas e/		4,000	4,500	4,500	5,000	5,000
Talc		1,349	2,049	2,080	1,076	1,000
Vermiculite		5,032	8,184	13,742	10,249	10,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	5,285	5,515	5,538	5,175	5,301 3/
Coke, metallurgical e/	do.	500	550	300 r/	600	600

e/ Estimated. r/ Revised.

1/ Table includes data available through August 4, 1998.

2/ "Mine output" figures are estimated from "metal" figures. "Metal" may include metal content of compounds/salts and may include cobalt recovered from nickel copper matte imported from Botswana for toll refining.

3/ Reported figure.

4/ Excludes toll refined nickel.

5/ Includes rough and ground quartz, as well as silica sand.

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TABLE 2
ZIMBABWE: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Asbestos		Shabanie and Mashaba Mines (Pvt.) Ltd. [African Associated Mines (Pvt.) Ltd., 100%]	Shabanie Mine, Zvishavane; Gaths and King Mines, Mashava	300
Chromite, gross weight		Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Zimasco) (Zimasco Consolidated Enterprises, 100%)	Peak Mine and Railway Block Mine at Shurugui and mines at Mutorshanga and Lalapanzi	500
Do.		Zimbabwe Alloys Ltd. (Zimalloys) (Anglo American Corp., 100%)	Great Dyke Mine, Mutoroshanga; Netherburn Mine at Lalapanzi; and Inyala Mine at Mberengwa	50
Do.		Local cooperatives	North Dyke	50
Coal		Wankie Colliery Co. (Pvt.) Ltd. (Private investors, 60%; Government, 40%)	Hwange	5,500
Cobalt	tons	Bindura Nickel Corp. Ltd. (Anglo American Corp., 65%; Government, 20%)	Shangani Mine, northwest of Shangani; Madziwa Mine, 50 kilometers northeast of Bindura; Trojan Mine, Bindura; Epoch Mine, Filabusi	150
Copper		Mhangura Copper Mines Ltd. (Zimbabwe Mining Development Corp., 55%)	Mhangura	16
Do.		Munyati Mining Ltd. Co. (Reunion Mining PLC, 75%; Zimbabwe Mining Development Corp., 25%)	Sanyati Mine, Sanyati	5
Do.		Bindura Smelter & Refinery Ltd. (Bindura Nickel Corp., 100%)	Solvent extraction-electrowinning plant at Bindura	2
Do.		Rio Tinto Zimbabwe Ltd.	Solvent extraction-electrowinning plant at Eiffel Flats	6 1/
Do.		Lomagundi Smelting & Mining (Pvt.) Ltd. (Merits Ltd., 100%)	Smelter at Alaska	35
Do.		do.	Refinery at Alaska	28
Diamond	carats	Auridam Zimbabwe (Pvt.) Ltd. (Auridam Consolidated NL, 50%; Redaurum Red Lake Mines Ltd., 50%)	River Ranch Mine, near Beitbridge	440,000
Gold	kilograms	Independence Mining (Pvt.) Ltd. (Lonhro PLC, 100%)	How Mine, Bulawayo; Athens Mine, Mvuma; Tiger Reef Mine, Kwekwe; Redwing Mine, Penhalonga; Shamva Mine, Shamva; Legion Dump, Kezi	3,800
Do.	do.	Ashanti Goldfields Zimbabwe (Pvt.) Ltd. (Ashanti Goldfields Co. Ltd., 82.4%, private investors, 17.6%)	Freda Rebecca Mine, Bindura	3,300
Do.	do.	Rio Tinto Zimbabwe Ltd. (RTZ Corp. PLC, 56%)	Renco Mine, 75 kilometers southeast of Masvingo; Patchway Mine, Kadoma; Brompton Mine, 2/ Kadoma; and Cam and Motor dump, Kadoma	2,800
Do.	do.	Falcon Gold Zimbabwe Ltd. (Falcon Investments S.A., 71.7%)	Dalny Mine, Chegutu; Venice Mine, Kadoma; Golden Quarry Mine, Shurugui; Old Nic Mine, Bulawayo	2,000
Do.	do.	Corsyn Consolidated Mines (Pvt.) Ltd. (Lonrho PLC, 100%)	Anzac Mine, Kwekwe; Arcturus Mine, Arcturus; Mazowe Mine, Mazowe; Muriel Mine, Mutorashanga	1,700
Do.	do.	Kinross Gold Corp.	Blanket Mine	1,100
Do.	do.	Zimbabwe Mining Development Corp. (Government, 100%)	Lexington Mine and Elvington Gold Mine, near Chegutu	1,000
Do.	do.	Anglo American Zimbabwe (Anglo American Corp. of South Africa)	Bubi Mine	900
Do.	do.	Connemara joint venture (First Quantum Minerals Ltd., 95%; Chase Minerals (Pvt.), 5%)	Connemara Mine, north of Gweru	800
Do.	do.	Casmyn Mining Zimbabwe (Pvt.) Ltd.	Turk Mine, north of Bulawayo	500
Do.	do.	Jena Mines (Pvt.) Ltd. [Zimbabwe Mining Development Corp., 50%; Trillion Resources (Pvt.) Ltd. Zimbabwe, 50%]	Jena Group, Kwekwe area	400
Iron and steel:				
Crude steel		Zimbabwe Iron and Steel Co. (Pvt.) Ltd. (Government, 89%)	Redcliff, near Gweru	240 3/

See footnotes at end of table.

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TABLE 2--Continued
ZIMBABWE: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Iron and steel--Continued:			
Iron ore, gross weight	Buchwa Iron Mining Co. [Zimbabwe Iron and Steel Co. (Pvt.) Ltd., 100%]	Buchwa West Mine, Buchwa; Ripple Creek Mine, near Redcliff	1,400
Ferroalloys:			
Ferrochromium, high-carbon	Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Zimasco) (Zimasco Consolidated Enterprises, 73%)	Smelter at Kwekwe	220
Ferrochromium, low-carbon	Zimbabwe Alloys Ltd. (Zimalloys) (Anglo American Corp., 100%)	Smelter at Gweru	40
Ferrochromium-silicon	do.	do.	55
Lithium	Bikita Minerals (Pvt.) Ltd. (Private, 100%)	Bikita Mine, 60 kilometers east of Masvingo	33
Nickel	Trojan Nickel Mines Ltd. (Bindura Nickel Corp., 100%)	Shangani, Madziwa, Trojan, and Epoch Mines	17
Do.	Bindura Smelter & Refinery Ltd. (Bindura Nickel Corp., 100%)	Smelter and refinery at Bindura	16
Do.	Rio Tinto Zimbabwe Ltd.	Empress Nickel Refinery, Eiffel Flats, northeast of Kadoma	11
Platinum-group metals kilograms	Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Zimasco) (Zimasco Consolidated Enterprises, 100%)	Mimosa Mines, east of Zvishavane	300
Phosphate	Dorowa Minerals (Pvt.) Ltd. (Chemplex Corp. Ltd., 100%)	Dorowa Mine, 90 kilometers west of Mutare	155
Vermiculite	Shawa Vermiculite (Pvt.) Ltd. (Private, 100%)	Shawa Mine, near Dorowa	39
Do.	Dinidza Vermiculite Mining Co. (Pvt.) Ltd. (Private, 100%)	Dinidza Mine, near Dorowa	10

1/ Empress Refinery toll refines nickel-copper matte for BCL Ltd. of Botswana.
2/ Brompton Mine closed in August 1997.
3/ Blast furnace No. 4 (capacity: 780,000 metric tons per year) remained shut in 1996.

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THE MINERAL INDUSTRIES OF

THE MIDDLE EAST

By Bernadette Michalski and Philip M. Mobbs

The 15 nations in the Middle East covered in this volume were home to 164 million people and encompass a land area of 6.2 million square kilometers. The Governments of most Middle Eastern nations continued to encourage foreign and private interests in mineral development. Iran's parliament ratified a new mining law and proposed privatization of a number of mineral industry operations. In Saudi Arabia, the Government created the Saudi Arabian Mining Co.-MA'ADEN.

In 1997, petroleum continues to be the most important mineral commodity for most of the countries in the region and remained for the most part, under Government control. In contrast to petroleum, the petrochemical industry, a major force in the Middle East, was largely open to private investment. In the case of nonfuel mineral commodities, two Middle Eastern countries were considered to be major import sources for the U.S. mineral industry—Israel for gemstones and Turkey for ferrochromium. At 472 million barrels (Mbbl), Saudi Arabia was the third leading supplier of crude oil to the United States, trailing only Venezuela (509 Mbbl) and Mexico (496 Mbbl); Kuwait (92 Mbbl) was the ninth largest crude oil supplier to the United States.

Hydrocarbon exploration continued in Iran, Israel, Jordan, Oman, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen. New fields came on-stream in Turkey and Yemen. In accordance with the United Nations Resolution 986, Iraq resumed limited oil exports in August with the larger share of the oil transiting through Turkey. Iran opened the long-awaited Bandar Abbas oil refinery during the year, with full capacity of 232,000 barrels per day (bbl/d) expected to be reached in 1998. Iran also opened a 4-billion-cubic-meters-per-year pipeline to bring natural gas into the northern part of the country from Turkmenistan. In Qatar, the second liquefied natural gas train at Qatar Liquefied Gas Co. was commissioned. An 80,000-bbl/d oil refinery came on-stream in Sharjah, United Arab Emirates.

The region's petrochemical industry is growing rapidly. In Kuwait, a $2 billion petrochemical complex at Shuayba opened in September with Government equity at 45%. A number of Saudi Arabian petrochemical complexes, under new construction or expansion, will come on-stream between 1997 and 2000, increasing the country's petrochemical production to 28 million metric tons per year.

Developments in the aluminum sector included Aluminium Bahrain's 35,000-metric-ton per-year (t/yr)-smelter-capacity expansion, raising capacity to nearly 500,000 t/yr; the commissioning of the 110,000-t/yr capacity Al-Mahdi aluminum smelter in Iran; and the addition of 130,000-t/yr-capacity reduction cells by Dubai Aluminum Co. Ltd. Other Middle Eastern metal operations included the development of an open-pit copper mine at Meiduk and a new copper smelter in Khatounabad, both in Iran; the installation of an 850,000-t/yr rolling mill, as Saudi Iron and Steel Co. continued its expansion; and the development of the Al-Amar gold deposit in Saudi Arabia. Gold exploration in Turkey suffered a setback when an administrative court annulled a segment of the Ovacık prospect mine-permitting process. Metal exploration continued in Oman and Saudi Arabia.

In 1997, three cement plants came online—the 730,000-t/yr-capacity plant at Umm Bab in Qatar, a 1-Mt/yr-capacity plant in Iran, and the Southern Province Cement Co.'s second plant with a capacity of 1.4 Mt/yr. Indo-Jordan Chemicals Co. Ltd.'s $170 million fertilizer plant opened. The operation included a 690,000-t/yr-capacity sulfuric acid plant and a 220,000-t/yr- capacity phosphoric acid plant. The Nippon Jordan Fertilizer Co. commissioned a 300,000-t/yr compound fertilizer plant in May.

Although petroleum and petrochemicals dominated the minerals sector of the Middle East, diversification efforts were being rewarded as value-added mineral and metal manufacturers continued to bring in additional revenues.

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TABLE 1
MIDDLE EAST: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1997 1/ 2/

(Thousand metric tons unless otherwise specified)

Country	Alumi-num e/	Boron	Cement, hydraulic e/	Chromite	Copper, mine Cu content	Gypsum e/	Natural gas: Plant liquids (thousand 42-gallon barrels)	Natural gas: Dry (million cubic meters)
Bahrain	490 3/	--	172 3/	--	--	--	3,977	8,030
Cyprus	--	--	1,000	--	4	150	--	--
Iran	92	(4/) e/	15,200	169 5/	117	8,900	22,000	43,000
Iraq	--	--	2,500	--	--	100 6/	10,000	3,000
Israel	--	--	6,700	--	--	50	--	20
Jordan	--	--	3,251	--	--	170	--	350
Kuwait	--	--	2,000	--	--	--	45,000	9,250
Lebanon	--	--	4,500	--	--	3	--	--
Oman	--	--	1,300	18	--	--	3,800	4,000
Qatar	--	--	700	--	--	--	22,000	21,500
Saudi Arabia	--	--	15,400 3/	--	1 e/	365	263,900	43,900
Syria	--	--	5,000	--	--	325	18,000	3,000 e/
Turkey	60	1,510	36,035 3/	1,864	35 e/	700	--	251
United Arab Emirates	398	--	6,000	61	--	90	110,000	37,300 e/
Yemen	--	--	1,200	--	--	80	2,600	70,000
Total, Middle East 7/	1,040	1,510	100,958	2,112	157	10,933	501,277	243,601
Total, world	21,400	3,070	1,551,000	12,500	11,400	104,000	2,372,500	2,313,768
Share of world total	5%	49%	7%	17%	1%	11%	21%	11%
United States	3,600	1,190	84,244 3/	--	1,940	18,600	788,035	535,188

Country	Nitrogen, N in ammonia e/	Petroleum, crude (thou-sand 42-gallon barrels) 8/	Phosphate rock e/ (gross weight)	Potash e/ K_2O equivalent	Salt e/	Steel, crude e/	Sulfur e/
Bahrain	360	14,159	--	--	--	--	66
Cyprus	--	--	--	--	--	--	--
Iran	880	1,337,360	--	--	1	6,322	900
Iraq	500	433,000	1,000 9/	--	250	300	475
Israel	57	36	4,047 9/	1,488	800	203	60
Jordan	--	--	6,075	649	50	30	--
Kuwait	432	732,574	--	--	100	--	664
Lebanon	--	--	--	--	4	--	--
Oman	--	323,755	--	--	--	--	30
Qatar	943	224,110	--	--	--	616	65
Saudi Arabia	1,405	3,080,235	--	--	90	2,539 3/	2,400
Syria	30	220,500	2,000	--	112 3/	70	10
Turkey	558	25	--	--	2,000	13,644 3/	226
United Arab Emirates	373	845,340	--	--	--	--	236
Yemen	--	135,000	--	--	110	--	--
Total, Middle East 7/	5,538	7,346,094	13,122	2,137	3,517	23,724	5,132
Total, world	101,000	27,135,195	138,000	25,700	201,000	795,000	53,600
Share of world total	5%	27%	10%	8%	2%	3%	10%
United States	13,200 10/	2,359,725	45,900	1,400	41,400	98,500	12,000

e/ Estimated.
1/ Table includes data available through January 1, 1999.
2/ Data may be different from that appearing in individual country production tables owing to availability of more-current data.
3/ Reported figure.
4/ Less than 1/2 unit.
5/ Concentrate.
6/ For cement production only. Information is insufficient to formulate reliable estimates for output for other uses (plaster, mortar, etc.).
7/ May not add to totals shown because of independent rounding.
8/ Includes lease condensate.
9/ Beneficiated.
10/ Synthetic anhydrous ammonia; excludes coke oven byproduct ammonia.

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THE MINERAL INDUSTRY OF

BAHRAIN

By Bernadette Michalski

In 1997, the mineral industry supplied about 90% of Government revenues and export earnings. The availability of natural gas for low-cost electric power generation has supplied the Nation's aluminum smelting and fabrication industries for more than a quarter of a century. Aluminium Bahrain's (ALBA) smelter capacity was expanded by 35,500 metric tons per year (t/yr) in the second quarter of 1997, raising total capacity to 496,500 t/yr. Alumina feedstock is imported principally from Australia. For more extensive coverage of the mineral industry of Bahrain, see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

TABLE 1
BAHRAIN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Aluminum, smelter output, primary metal		447,514	447,000	450,709	461,245 r/	489,847
Cement		225,000	225,000 e/	196,568 r/	192,000 r/	171,854
Gas, natural:						
Gross	million cubic meters	9,798	9,946	12,538 r/	10,210 r/	10,500 e/
Dry	do.	6,926	7,091	7,205	6,950 e/	8,030
Methanol		428,458	419,322	427,350	384,558 r/	447,969
Natural gas plant liquids:						
Propane	thousand 42-gallon barrels	1,471	1,455	1,375	1,272 r/	1,213
Butane	do.	1,116	1,190	1,163	1,087 r/	1,048
Naphtha	do.	1,800	1,863	1,848	1,784 r/	1,716
Nitrogen, N content of ammonia		348,375	337,506	357,504	358,000 e/	360,000 e/
Petroleum:						
Crude	thousand 42-gallon barrels	14,875	14,695	14,468	14,124	14,159
Refinery products:						
Gasoline	do.	9,228	7,704	7,766	8,139 r/	7,377
Jet fuel	do.	4,410	7,106	6,219	6,450 r/ e/	6,300 e/
Kerosene	do.	12,282	10,409	11,327	11,600 r/ e/	11,200 e/
Distillate fuel oil	do.	29,360	28,852	31,027	21,407 r/	19,188
Residual fuel oil	do.	22,188	20,896	20,807	30,430 r/	33,000 e/
Other	do.	12,190	13,630	14,728	16,800 r/ e/	14,310 e/
Total	do.	89,658	88,597	91,874	94,826 r/	91,375
Sulfur		53,700	52,312	55,390	74,282 r/	66,334

e/ Estimated. r/ Revised.
1/ Table includes data available through April 1, 1998.

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THE MINERAL INDUSTRY OF

CYPRUS

By Bernadette Michalski

The nation's mineral industry is focused on copper and an extensive range of nonmetallic minerals. The value of mining and quarrying products in 1997 was approximately $128 million, more than two-thirds of which was attributed to the copper operations and the hydraulic cement industry. *(See table 1.)* The solvent extraction and electrowinning project at the Skouriotissa copper mine attained capacity levels by the close of 1997, its first full year of operation. The plant is designed to produce 8,000 metric tons per year (t/yr) of 99.999% copper cathode, replacing a cementation operation. Virtually all production is exported. *(See table 2.)* The Hellenic Mining Co. holds 44% equity, Oxiana Resources NL of Australia 43.7%, Mid-East Mining 5%, Sterina Kimatiki 4.15%, and Hellenic Bank 3.15%. A feasibility study for expansion to 20,000 t/yr is under consideration. Other significant mineral production includes aggregate, cement, dimension stone, and umber. For more extensive coverage of the mineral industry of Cyprus, see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

TABLE 1
CYPRUS: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Thousand metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Copper: 3/						
Gross weight	metric tons	278	--	--	NA	NA
Cu content	do.	103	--	--	1,499	3,900 4/
INDUSTRIAL MINERALS						
Cement, hydraulic		1,089	1,044	1,021	1,000	1,000
Clays:						
Bentonite	metric tons	51,689 r/	50,441	71,773	70,927	48,076 4/
Other:						
For brick and tile manufacture		450	475	407	400 e/	450
For cement manufacture e/		350	375	350	350	350
Total		800	850	757	750	800
Gypsum:						
Crude	metric tons	90,000	180,000	133,208	150,468	150,500
Calcined	do.	3,000	4,000	4,000 e/	4,000 e/	4,000
Lime, hydrated	do.	6,100	5,525	5,530	5,500 e/	5,500
Stone, sand, and gravel:						
Limestone, crushed (Havara)		3,000	3,000 e/	3,200	3,000 e/	3,000
Marble e/		50	50	50	50	50
Marl, for cement production		1,500	1,600	2,000	1,600 e/	1,600
Sand and gravel e/ 4/		6,000 5/	6,000	6,000	6,000	6,000
Building stone		100	1,436	974	800	800
Umber	metric tons	6,000 e/	9,000 e/	5,415	4,604	5,000
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:						
Liquefied petroleum gases	thousand 42-gallon barrels	308	350	375 r/ 5/	375 r/ e	375
Gasoline	do.	799	900	900 r/ 5/	900 r/ e	900
Kerosene and jet fuel	do.	346	400	400 e/	400 e/	400
Distillate fuel oil	do.	1,886	2,450	2,300 r/ 5/	2,300 r/ e	2,300
Residual fuel oil	do.	2,000	2,500 e/	2,500 r/ 5/	2,500 r/ e	2,500
Other	do.	208	200 e/	300 r/ 5/	300 r/ e	300
Total	do.	5,547	6,800	6,775 r/ 5/	6,775 r/ e	6,775

e/ Estimated. r/ Revised. NA Not available.

1/ Table includes data available through April 30, 1998.

2/ Mineral production data from the northern Turkish-occupied section of the country are not included in this table because available information is inadequate to make reliable estimates of output levels.

3/ Hellenic Mining Co. ceased copper cementation operations from Skouriotissa Mine talings in 1993. Activity resumed in July 1996 when a solvent extraction-electrowinning plant, designed to produce 8,000 metric tons per year was commissioned.

4/ Includes crushed aggregate.

5/ Reported figure.

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TABLE 2
CYPRUS: EXPORTS OF MINERAL COMMODITIES IN 1996 1/ 2/

(Metric tons unless otherwise specified)

Commodity		Total	Destinations	
			United States	Other (principal)
METALS				
Aluminum, metal including alloys:				
Scrap		72	--	United Kingdom 17; Mauritius 14; Ireland 13.
Unwrought		559	--	Netherlands 499; Germany 60.
Semimanufactures		408	--	United Kingdom 260; Ireland 52; Lebanon 51.
Copper, metal including alloys:				
Unwrought		1,492	--	United Kingdom 1,043; Greece 306; Italy 142.
Semimanufactures	value, thousands	$6	--	Poland $4; Hong Kong $1; Sudan $1.
Gold, metal including alloys, unwrought and partly wrought	kilograms	8	--	United Arab Emirates 5; Yugoslavia 3.
Iron and steel, metal, semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		6	--	Germany 2; Lebanon 2; United Arab Emirates 2.
Clad, plated, coated		92	--	Mainly to Israel.
Of alloy steel		3	--	All to Germany.
Bars, rods, angles, shapes, sections		25	--	Nigeria 18; Armenia 5; France 2.
Wire		897	--	United Kingdom 584; Ireland 192; Greece 77.
Tubes, pipes, fittings		136	--	United Arab Emirates 67; Lebanon 62; Greece 6.
Lead:				
Oxides		140	--	All to Kenya.
Metal including alloys:				
Scrap		317	--	All to Greece.
Semimanufactures		2	--	All to United Kingdom.
Zinc, blue powder 3/		43	--	All to Italy.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc.		20	--	All to Israel.
Grinding and polishing wheels and stones		99	--	Yugoslavia 94; Greece 5.
Cement		529,407	--	Israel 280,409; Lebanon 243,551; Spain 5,297.
Clays, crude:				
Bentonite		31,397	--	United Kingdom 29,554; Denmark 1,226; Finland 559.
Unspecified		80	--	All to Egypt.
Fertilizer materials:				
Crude, n.e.s.		3	--	Thailand 2; Israel 1.
Manufactured:				
Nitrogenous		3	--	All to Lebanon.
Potassic		1	--	All to Jordan.
Unspecified and mixed		136	--	Romania 118; Israel 14; Syria 2.
Gypsum and plaster		150,921	--	Israel 113,303; Lebanon 36,038; Russia 1,580.
Precious and semiprecious stones other than diamond, natural	value, thousands	$131	--	All to Saudi Arabia.
Salt and brine		7	--	United Kingdom 2; unspecified countries 5.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		3,552	--	Israel 2,702; Italy 616; Greece 194.
Worked		72	--	Greece 20; Poland 20; Kuwait 17.
Gravel and crushed rock		7	--	All to Nigeria.
Sand other than metal-bearing		23	--	Greece 13; Russia 10.
Sulfur, elemental, crude including native and byproduct		72	--	All to Israel.
Vermiculite, perlite, chlorite		30	--	All to Egypt.
Other:				
Crude		4,646	2,957	United Kingdom 657; Egypt 188; Canada 163.
Precious metals, n.e.s., waste and sweepings	kilograms	2,850	--	All to United Kingdom.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		11	--	France 6; Ukraine 5.
Petroleum:				
Crude		1	--	All to Jordan.
Refinery products:				
Keresene and jet fuel		12,864	--	All to unspecified countries.
Distillate fuel oil		10,402	--	Do.

See footnotes at end of table.

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TABLE 2--Continued
CYPRUS: EXPORTS OF MINERAL COMMODITIES IN 1996 1/ 2/

(Metric tons unless otherwise specified)

Commodity	Total	Destinations	
		United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS--Continued			
Petroleum--Continued:			
Refinery products--Continued:			
Lubricants	90	--	Egypt 74; Jordan 16.
Residual fuel oil	63,603	--	Italy 22,222; unspecified countries 41,381.
Bituminous mixtures	1	--	All to Ukraine.

1/ Table prepared by Glenn J. Wallace.
2/ Excludes reexports.
3/ Includes zinc dust, flakes, powders.

Source: United Nations Statistical Office (microfiche).

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TABLE 3
CYPRUS: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS				
Akaline-earth metals	value, thousands	$1	--	All from United Kingdom.
Aluminum:				
Oxides and hydroxides		10	(2/)	United Kingdom 8; Italy 2.
Metal including alloys:				
Scrap		22	--	Czech Republic 16; Denmark 6.
Unwrought		5,280	--	Greece 3,364; Canada 1,799; Germany 98.
Semimanufactures		2,802	16	Greece 1,862; Italy 299; United Kingdom 176.
Antimony, metal including alloys, all forms		1	--	Mainly from Lebanon.
Cadmium, metal including alloys, all forms	value, thousands	$1	--	All from Italy.
Chromium:				
Oxides and hydroxides		39	--	Mainly from France.
Metal including alloys, all forms	value, thousands	$1	--	All from Germany.
Cobalt:				
Oxides and hydroxides		1	--	Mainly from Italy.
Metal including alloys, all forms	value, thousands	$6	--	Germany $5; United Kingdom $1.
Copper, metal including alloys:				
Unwrought	do.	$664	$4	Australia $582; United Kingdom $64; Italy $11.
Semimanufactures		2,946	127	United Kingdom 1,255; Belgium-Luxembourg 448; Greece 385.
Gold:				
Waste and sweepings	kilograms	20	--	All from United Kingdom.
Metal including alloys, unwrought and partly wrou	do.	3,382	18	Germany 2,099; United Kingdom 868; Belgium-Luxembourg 24
Iron and steel:				
Ore and concentrate, excluding roasted pyrite		62	--	United Kingdom 42; France 20.
Metal:				
Scrap		47	--	Lebanon 39; Sweden 8.
Pig iron, cast iron, related materials		790	--	Romania 741; United Kingdom 40; Italy 4.
Ferroalloys:				
Ferromanganese		18	--	Norway 14; Russia 4.
Ferrosilicon	value, thousands	$1	--	All from China.
Silicon metal 3/	do.	$4	$1	Mainly from Israel.
Unspecified	do.	$1	--	All from Belgium-Luxembourg.
Steel, primary forms	do.	$4	--	Germany $1; Israel $1; unspecified Asia $2.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		20,637	39	Hungary 8,432; Russia 3,261; Slovakia 2,873.
Clad, plated, coated		16,999	--	Germany 3,875; Italy 3,401; Greece 3,332.
Of alloy steel		1,542	17	Germany 409; France 270; Italy 244.
Bars, rods, angles, shapes, sections		158,703	(2/)	Moldova 36,935; Ukraine 31,191; Italy 30,654.
Rails and accessories		57	--	Greece 32; Netherlands 13; United Kingdom 11.
Wire		3,814	(2/)	Belgium-Luxembourg 1,114; United Kingdom 689; South Africa 449.
Tubes, pipes, fittings		18,219	5	Egypt 7,602; United Kingdom 2,024; Greece 1,910.
Lead:				
Oxides		184	--	Mainly from United Kingdom.
Metal including alloys:				
Unwrought		2,463	--	United Kingdom 1,437; Greece 513; Israel 279.
Semimanufactures		290	(2/)	Bulgaria 191; United Kingdom 40; Netherlands 26.
Magnesium, metal including alloys, semimanufactures		4	--	Mainly from Greece.
Manganese oxides		43	--	Germany 24; Brazil 16; United Kingdom 3.
Mercury	value, thousands	$2	--	All from Sweden.
Nickel:				
Matte and speiss	do.	$4	--	All from Israel.
Metal including alloys:				
Unwrought	do.	$7	$7	
Semimanufactures		2	--	Mainly from Austria.
Platinum-group metals, including alloys, unwrought and partly wrought	alue, thousands	$188	$46	Germany $123; United Kingdom $17; Italy $2.

See footnotes at end of table.

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TABLE 3--Continued
CYPRUS: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
METALS--Continued				
Silver, metal including alloys, unwrought and partly w	value, thousands	$2,342	--	United Kingdom $1,155; Germany $772; Spain $122.
Tin, metal including alloys:				
Unwrought		1	--	All from United Kingdom.
Semimanufactures		120	(2/)	Greece 61; United Kingdom 34; South Africa 21.
Titanium:				
Ore and concentrate		80	--	South Africa 40; Sri Lanka 40.
Oxides		367	204	United Kingdom 119; Germany 41; Canada 1.
Metal including alloys:				
Unwrought, including waste and scrap		8	--	Mainly from United Kingdom.
Semimanufactures	value, thousands	$3	--	Germany $2; Italy $1.
Tungsten, metal including alloys, semimanufactures	do.	$1	--	All from United Kingdom.
Zinc:				
Oxides		48	--	Germany 41; United Kingdom 6; Greece 1.
Blue powder 4/		1	--	All from Germany.
Metal including alloys:				
Unwrought		277	--	Russia 170; Netherlands 82; Spain 21.
Semimanufactures		4	--	Greece 3; Germany 1.
Zirconium ore and concentrate		10	--	All from Netherlands.
Other:				
Oxides and hydroxides	value, thousands	$5	--	Germany $2; United Kingdom $2; France $1.
Metalloids 5/		1	--	All from China.
Precious metals, n.e.s., waste and sweepings	kilograms	8,360	200	Greece 8,070; United Kingdom 90.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc.		384	5	Greece 371; India 8.
Artificial corundum	value, thousands	$2	--	Germany $1; Switzerland $1.
Grinding and polishing wheels and stones		224	(2/)	Italy 130; Germany 27; United Kingdom 15.
Barite and witherite		7	--	Germany 5; United Kingdom 2.
Boron materials, oxides and acids		7	--	United Kingdom 5; Italy 1; Lebanon 1.
Bromine, fluorine, iodine		8	6	Germany 1; United Kingdom 1.
Cement		128	--	Italy 50; France 42; United Kingdom 34.
Chalk		682	--	Italy 475; France 96; United Kingdom 89.
Clays, crude:				
Bentonite		72	2	United Kingdom 58; Italy 6; Hungary 3.
Kaolin		16,384	--	Greece 15,831; United Kingdom 287; Spain 223.
Unspecified		337	--	Greece 175; United Kingdom 102; Germany 54.
Diamond, natural:				
Gem, not set or strung	value, thousands	$8,379	$53	Belgium-Luxembourg $2,493; Russia $1,959; Israel $1,152.
Industrial stones	do.	$8	--	Israel $6; India $2.
Diatomite and other infusorial earth		195	143	Greece 22; Germany 21; United Kingdom 8.
Fertilizer materials:				
Crude, n.e.s.		508	--	Israel 380; Greece 57; Lebanon 37.
Manufactured:				
Ammonia		27	--	United Kingdom 15; Belgium-Luxembourg 6; Greece 5.
Nitrogenous		11,552	9	Bulgaria 7,537; Romania 2,000; France 1,274.
Phosphatic		1,104	--	All from Romania.
Potassic		463	--	Israel 286; Germany 173; Spain 3.
Unspecified and mixed		45,839	117	Greece 42,463; Israel 1,997; Belgium-Luxembourg 331.
Graphite, natural		22	--	All from Italy.
Gypsum and plaster		175	--	Germany 113; Greece 17; Italy 15.
Lime	value, thousands	$1	--	All from Israel.
Magnesium compounds:				
Magnesite, crude		5	--	All from United Kingdom.
Oxides and hydroxides		32	--	Greece 16; Netherlands 10; Italy 2.
Mica, crude including splittings and waste		28	--	Norway 19; United Kingdom 9.
Pigments, mineral, iron oxides and hydroxides, processed		156	1	United Kingdom 111; China 20; Belgium-Luxembourg 10.

See footnotes at end of table.

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TABLE 3--Continued
CYPRUS: IMPORTS OF MINERAL COMMODITIES IN 1996 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources: United States	Sources: Other (principal)
INDUSTRIAL MINERALS--Continued				
Precious and semiprecious stones other than diamond:				
Natural	value, thousands	$796	$1	Thailand $278; Zambia $225; United Kingdom $188.
Synthetic	do.	$205	--	Switzerland $101; Austria $43; Thailand $19.
Quartz crystal, piezoelectric	do.	$2	--	All from Austria.
Salt and brine		8,099	--	Israel 2,775; Greece 2,212; Egypt 1,650.
Sodium compounds, n.e.s.:				
Soda ash, manufactured		1,063	(2/)	United Kingdom 675; Italy 254; France 80.
Sulfate, manufactured		2,228	--	Spain 1,079; Germany 549; Austria 380.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		30,545	--	Italy 21,923; Greece 8,492; Spain 43.
Worked		20,819	--	Italy 13,242; Greece 6,453; Spain 527.
Dolomite, chiefly refractory-grade		49	--	Norway 46; Greece 3.
Gravel and crushed rock		3,859	5	Italy 1,990; Greece 1,750; France 42.
Quartz and quartzite		83	--	Greece 56; Germany 21; Belgium-Luxembourg 3.
Sand other than metal-bearing		1,243	--	Belgium-Luxembourg 358; United Kingdom 227; Germany 217.
Sulfur:				
Elemental:				
Crude including native and byproduct		1,491	--	Egypt 1,250; Lebanon 240; Israel 1.
Colloidal, precipitated, sublimed		95	--	Egypt 92; United Kingdom 3.
Dioxide		75	--	Greece 54; Germany 21.
Sulfuric acid		351	--	Belgium-Luxembourg 181; Netherlands 149; Greece 19.
Talc, steatite, soapstone, pyrophyllite		227	--	Norway 112; Finland 36; Netherlands 30.
Vermiculite, perlite, chlorite		1,560	--	Greece 1,500; Italy 60.
Other:				
Crude		87	--	Israel 36; Ireland 22; Germany 13.
Slag and dross, not metal-bearing		15,443	--	Italy 15,422; Greece 20; United Kingdom 1.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		21	(2/)	Mainly from Greece.
Carbon black		6	(2/)	Germany 4; Netherlands 1; United Kingdom 1.
Coal:				
Anthracite		141,454	100,165	Kuwait 27,500; Germany 13,750; Poland 20.
Bituminous		18,956	--	All from Russia.
Briquets of anthracite and bituminous coal		154	21	Australia 115; China 18.
Lignite including briquets		545	--	Australia 478; Germany 49; South Africa 18.
Coke and semicoke		317	--	Belgium-Luxembourg 161; Germany 93; Italy 62.
Gas, natural:				
Gaseous	value, thousands	$1	--	All from Italy.
Liquefied		8	--	Do.
Peat including briquets and litter		8,779	--	Germany 4,319; Ireland 2,586; Netherlands 1,298.
Petroleum:				
Crude		748,947	--	Russia 379,025; Egypt 328,512; Syria 41,410.
Refinery products:				
Liquefied petroleum gas		24,462	--	Greece 14,825; Saudi Arabia 4,324; Lebanon 2,807.
Gasoline		101,122	31	Greece 69,185; Italy 19,135; France 7,901.
Mineral jelly and wax		239	--	Greece 57; Israel 47; Hungary 38.
Keresene and jet fuel		285,911	--	Greece 126,576; Israel 104,796; Libya 37,259.
Distillate fuel oil		224,509	--	Russia 148,295; Israel 64,154; France 4,867.
Lubricants		13,131	196	Italy 4,085; Greece 3,167; United Kingdom 2,507.
Residual fuel oil		599,181	--	Syria 566,946; Italy 32,234.
Bitumen and other residues		22,891	--	Italy 11,848; Spain 5,546; Saudi Arabia 3,995.
Bituminous mixtures		754	2	United Kingdom 327; Syria 240; Greece 80.

1/ Table prepared by Glenn J. Wallace.
2/ Less than 1/2 unit.
3/ May include high-purity silicon.
4/ Includes zinc dust, flakes, and powders.
5/ Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

Source: United Nations Statistical Office (microfiche).

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THE MINERAL INDUSTRY OF

IRAN

By Bernadette Michalski

Although petroleum continued to provide the bulk of the country's foreign exchange, supplying 83% of hard currency revenues in the Iranian calendar year that ended on March 20, 1998, Iran has the potential for a significantly diversified mineral industry. The country remained the world's fourth largest producer of crude oil averaging more than 3.66 million barrels per day (Mbbl/d). Crude oil prices dropped by as much as 40% in the last one-half of the Iranian calendar year and required serious budget revisions and reemphasis of the need for a more-diversified economy. Other commercial mineral and metal outputs included aluminum, chromite, copper, gypsum, iron and steel, and lead and zinc.

Government Policies and Programs

The Government's second 5-year plan, covering Iranian calendar years 1995-96 through 1999-2000, includes a progressive liberalization of the economy with heightened private sector participation. At least 2,400 state-owned companies, including 30 in the petroleum, petrochemical, steel, and power sectors, are to be privatized. Foreign investment in all nonoil industrial projects totaled $782 million in the first 3 years of the plan. The Government has authorized $700 million to be raised from abroad by the Iranian steel sector and $400 million by the copper sector in the 1998-99 Iranian year.

During the second 5-year plan, subsidies on petroleum were to be substantially reduced from $10 billion at the close of the first 5-year plan to $5 billion at the close of the second plan. Subsidies on domestic consumption of petroleum, however, were estimated to be $11 billion in 1997-98 in spite of 25% increases in consumer prices for petroleum products in each of the last 3 years (Arab Petroleum Research Center, 1998).

In November 1997, Iran's parliament ratified a new mining bill, presenting guidelines for mineral exploration and exploitation. The bill includes outlines of required qualification standards for applicant companies and describes the mechanism for securing foreign financing under buy-back programs.

Production

Expansion activities at the Gol-e Gohar iron ore mine accounted for increased production. Iran also is a significant producer of industrial minerals, ranking as the world's third largest producer of gypsum, mainly from the mines in the Semanan region about 200 kilometers (km) east of Tehran. During the past 4 years, crude oil production has been relatively stable, approaching 3.7 Mbbl/d with sustainable capacity near 3.8 Mbbl/d. *(See table 1.)* Onshore fields produced 3.2 Mbbl/d, and offshore, 0.5 Mbbl/d. Output was running at more than one-half the peak rate reached in the mid-1970's, when production exceeded 6 Mbbl/d and the sustainable capacity approached 7 Mbbl/d.

Trade

Export revenues for the Iranian calendar year 1996-97 were $22.5 billion, including $19.3 billion from oil and gas exports. In Iranian year, 1997-98, oil export revenues dropped to an estimated $15 billion (Arab Petroleum Research Center, 1998). Revenues from metal exports alone were reported to be $80.5 million in the first one-half of the year. As Iran fell further behind on its largely short-term debt, it renegotiated payment schedules with its major debtholders. Debt service repayment absorbed more than one-third of Iran's oil earnings.

Structure of the Mineral Industry

The overall management of the minerals sector was under the auspices of the Ministry of Mines and Metals. The Ministry's authority covers all mining, smelting, and refining industries except oil and gas, which were under the Ministry of Petroleum.

The Government announced the offering for privatization of at least 30 companies directly or indirectly related to the mining industry.

Commodity Review

Metals

Aluminum.—Primary aluminum production was, for the most part, derived from the reconstructed 120,000-metric-ton-per-year (t/yr)-capacity Iranian Aluminium Company plant in Arak. The plant is scheduled for 70,000-metric-ton (t) capacity expansion in the near future.

The Almahdi Aluminum Corp., a joint venture between the Ministry of Mines and Metals (60%) and the International Development Corp. of Dubai (40%), brought the Al-Mahdi aluminum smelter on-stream. Originally scheduled to come on-stream in 1994, the 110,000-t/yr-capacity aluminum smelter at Bandar Abbas began production in 1997 at a cost of $1.6 billion. The eventual capacity will be 220,000 t/yr, which is anticipated by 2000.

Chromium.—Several small chromite deposits associated with ophiolite belts are being exploited in the southern region of the Kerman province. In 1997, these mines yielded 282,000 t of run of mine ore. About one-half of the output was consumed by the

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Faryab Mining and Chrome Smelting Co. ferroalloy refinery near Bandar Abbas.

Copper.—A new copper smelter was being built in Khatounabad, 20 kilometers (km) from the Sar Cheshmeh copper complex in southeastern Iran. The China National Non-Ferrous Metals Co. was commissioned to build the $106 million copper smelter with a capacity of 80,000 t/yr. Iran was expected to pay for about $17 million of the cost through copper exports to China.

A new open-pit copper mine at Meiduk 120 km northwest of Sar Cheshmeh, was under development with the assistance of Outomec, a subsidiary of Finland's Outokumpu Oy. The economic reserves of the deposit vary from 50 million to 125 million metric tons (Mt) depending upon copper prices under consideration. The project includes an on-site concentrator to treat from 3 million to 7 million metric tons per year (Mt/yr) of ore grading about 1.1% copper. The Meiduk Mine is expected to yield about 45,000 t/yr of copper; in concentrate (U.S. Embassy, Stockholm, Sweden, 1997).

Iron and Steel.—The National Iranian Steel Co. (NISCO) plans to construct iron ore beneficiation plants at Choghard and Se Chahun. The iron content of the mined ore is from 24% to 40%, and the grade of concentrate is to be 66%. The plants will have the capacity to produce a total of 3.3 Mt/yr of blast-furnace-grade concentrate for the domestic steelmaking industry at the Isfahan Steel works and for export. Demands of the steel manufacturing industry prompted increased domestic iron ore output to sustain Government-owned steel plants. Iran has four main iron mines—Gol-e Gohar, 55 km southwest of Sirjan, approached 5 Mt of ore output in 1997; Choghard in Bafg, 200 km east of Yazd, produced 4.5 Mt/yr of mill concentrate; and the Samgan Mine, near Afghanistan border about 250 km southeast of Mashed, was undergoing a feasibility study for a planned expansion to 3.4 Mt/yr.

Direct reduction iron (DRI) production was growing at a rapid pace as 12 gas-fueled DRI modules, with a total capacity of 5.84 Mt/yr, were either in operation or were under construction at the Ahwas and the Mobarahek DRI plants.

Lead and Zinc.—Most of the nation's lead and zinc production was derived from three deposits—Angouran, Irankouh, and Kushk. While most lead and zinc companies exported concentrate, the 40,000-t/yr-capacity lead smelter at Angouran produced lead bar in quantities well below capacity level. A 60,000-t/yr zinc smelter, also at Angouran, started up in 1997. A second zinc smelter, with the capacity of 27,000 t/yr, was proposed for the Kushk Mine, near Yazd.

Industrial Minerals

Iran produces a wide variety of industrial minerals, including cement, clays, dimension stone, gypsum, phosphate, and salt. Suitable limestone deposits for cement production are located close to major cities. Iran's 22 cement manufacturers sustain a combined total capacity of 22 Mt/yr. The largest of these companies is the Teheran Cement Co., with a total capacity of 2.6 Mt/yr from six lines; Kerman Cement Co., with a total capacity of 1.2 Mt/yr; and Fars Cement Co., with a total capacity of 1.0 Mt/yr. The Hornuzgan Cement Co. commissioned a 1-Mt/yr-capacity plant in June 1997 and expects to commission another one of like size in December 1998.

Mineral Fuels

Coal.—The Kerman area Babnizou and Pabedana coal mines, operated by NISCO, supplied about 60% of the Nation's coking coal requirements with the remainder supplied through imports. Development began on a major coal deposit at Tabas, 300 km northeast of Yazd. The underground mine is projected to have a production capacity of 3.5 Mt/yr.

Natural Gas.—The Government plans to expand natural gas production to meet growing domestic demand, which has increased by more than 30% since 1992. Natural gas for injection purposes alone is projected to reach 128 million cubic meters per day (Mm^3/d) by 2000 compared with 85 Mm^3/d in 1997. Iran's most significant exploration project in 1997 was the confirmation of 60 billion cubic meters of gas at the Bibi Hakimeh Field, which will be developed for injection purposes.

In spite of U.S. sanctions legislation, development plans for the South Pars natural gas field progressed as a consortium of Total SA (40%), Gazprom (30%), and Petronas (30%) signed a $2 billion contract in September 1997 to develop Phases 2 and 3 of the field. When developed, the field is expected to produce 56 Mm^3/d of natural gas.

At yearend, a $190 million, 200-km pipeline with an initial capacity of 4 billion cubic meters per year was opened bringing gas from Turkmenistan's southwestern Korpedzhe Gasfield into Iran's domestic natural gas grid. Iran will benefit from the pipeline because it will reduce the cost of pumping gas from the southern Iranian fields about 1,500 km away (Financial Times, 1998).

Iran has signed an agreement with Turkey for the delivery of natural gas beginning in 1999. Initial shipments will be 2 billion cubic meters per year rising to 10 billion cubic meters per year in 2002.

Petrochemicals.—The National Petrochemical Company reported earnings of $1.5 billion from petrochemical exports in Iranian year 1996-97. Iran exports only 20% of its petrochemical output but expects to raise that to 70% in 6 years.

The first phase of the 650,000-t/yr-capacity Tabriz Petrochemicals Complex came on-stream in February 1997 with facilities to produce 136,000 t/yr of ethylene, 56,000 t/yr of propylene, 100,000 t/yr of polyethylene, and 55,000 t/yr of benzene. The second phase of the complex is scheduled to come on-stream in 1998 with the capacity to produce 95,000 t/yr of styrene and 80,000 t/yr of polystyrene.

Petroleum.—Crude oil production, including lease condensate, averaged more than 3.66 Mbbl/d, including 0.5 Mbbl/d from offshore fields in 1997. Domestic oil consumption has registered a 40% increase since 1991. Iran's crude oil exports were 2.38 Mbbl/d down from 2.63 Mbbl/d in 1996 owing, in part, to the startup of the Bandar Abbas refinery in September. By 2000, the

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National Iranian Oil Co. (NIOC) plans to increase crude oil production capacity to 5 Mbbl/d, including 1.2 Mbbl/d from offshore fields. Onshore development work is presently confined to the installation of natural gas injection facilities to improve long-term recovery rates and to maintain pressure in oil reservoirs.

The country's nine existing oil refineries are operated by the National Oil Refining and Distribution Company and have a throughput capacity of 1.44 Mbbl/d.

Reserves

NIOC increased its estimate of proven oil reserves to 93 billion barrels in 1997 from 88 billion barrels in 1996. Most of the country's liquid hydrocarbon reserves are located in the Southern Province particularly the Luristan-Khuzestan Basin, which contains 90% of total onshore crude oil reserves. Most of the remainder is located in the offshore fields of the Gulf.

Iran's proven gas reserves are 23 trillion cubic meters (Arab Petroleum Research Center, 1998). Iran has 2.6 billion metric tons of copper reserves. (Reuters, September 22, 1997, Iran to privatize some mined to raise funds, accessed September 22, 1997, at URL http://biz.yahoo.com/finance/97/09/22/70023-z00=1.html).

Infrastructure

Major investments are required for further development of the nation's infrastructure. Lack of adequate transportation systems and access to power generation hampers mineral-resource development. There are 158,000 km of highway in the country. Pipelines for crude oil total 5,900 km; for petroleum products, 3,900 km; and for natural gas, 4,550 km. Total installed electricity generating capacity exceeded 21,000 megawatts (MW) in 1997. Most of this capacity is attributed to thermal power plants. Hydroelectric power station capacity is 2,500 MW. It is expected to double to 5,000 MW by 2000 when 3 plants now under construction are scheduled for completion.

Outlook

Iran must diversify its industrial base to reduce its reliance on the oil sector, to increase nonoil exports, and to produce domestically many goods that it now imports. Expansion of the mineral industry can be expected as trends favoring privatization and foreign investment continue.

The metals sector offers the most promising avenue for diversification. Here, Iran has a number of comparative advantages, such as low labor costs and abundant energy from natural gas when it is developed. In terms of steel production, there are sizable, if relatively low-grade, iron ore deposits, and domestic supplies of coking coal and limestone which could support the development of a significant steel industry.

Iran's geographic position also offers opportunities as a potential export; route for landlocked crude oil of Central Asia.

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Major Sources of Information

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TABLE 1
IRAN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Aluminum:						
Bauxite, gross weight		100,000 e/	68,000 r/	148,000 r/	150,000 r/	150,000
Metal, primary ingot		109,190	116,200 r/	119,400 r/	80,100 r/	92,300
Arsenic, orpiment and realgar, concentrates e/		500	500	500	500	492
Chromium, chromite, mine output: Concentrate (48% to 50% Cr_2O_3):						
Gross weight		124,300 r/	354,100 r/	371,100 r/	130,220 r/	168,984 3/
Cr_2O_3 content e/		56,250 r/	173,500 r/	181,840 r/	63,800 r/	82,800
Copper:						
Mine output:						
Ore mined (1% to 1.2% Cu):						
Gross weight	thousand tons	10,800	12,400	13,150	14,150 r/ 3/	14,200
Cu content		86,600	100,040	120,000 e/	120,000	117,300
Concentrate (29% to 35% Cu):						
Gross weight e/		290,000	360,000	325,000	320,000	320,000
Cu content		86,600	117,900	102,200 r/	107,600 e/	108,000
Metal:						
Smelter output, blister/anode		85,000	131,800 r/	106,100 r/	99,100 r/	99,000
Refined output, cathode		84,900	90,200	90,400	99,200 r/	103,300
Gold, mine output, Au content 4/	kilograms	417	723	630 r/	640 r/	684 3/
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	9,870	8,690	9,080 e/	9,850 r/ 3/	12,750
Fe content e/	do.	4,800	4,300	4,500	4,800 r/	6,300
Metal:						
Pig iron	do.	1,961	1,883	1,532	1,867 3/	2,053
Direct-reduced iron	do.	1,631	2,861	3,301	3,778	4,380 3/
Ferrochromium		--	7,150 r/	11,900 r/	10,500 r/	11,450 3/
Ferrosilicon e/		--	--	10	20	20
Steel, crude, ingots and casti	do.	3,672	4,498	4,696	5,415	6,322 3/
Lead:						
Mine output, concentrate (56% to 60% Pb):						
Gross weight		22,000	30,000	30,000 e/	30,000 e/	37,000
Pb content		14,700 r/	18,300	15,900	15,700 e/	18,200
Refinery output, includes secondary		52,000	51,300	45,200	46,900 r/	49,400
Manganese, mine output, (30% to 35% Mn):						
Gross weight		75,978	96,115 r/	99,332 r/	100,000 r/	135,000
Mn content e/		24,320 r/	30,757 r/	32,000 r/	32,000 r/	40,000
Molybdenum, mine output, concentrate (56% Mo): e/						
Gross weight		1,200	1,200	1,600	1,600	1,800
Mo content		700	670	560	560	600
Silver, mine output, Ag content e/		60	60	60	60	60
Zinc, mine output, concentrate (50% to 55% Zn):						
Gross weight e/		154,000	146,000	290,000	152,000	132,000
Zn content		77,000	73,000 r/	145,100 r/	76,300 r/	76,500
INDUSTRIAL MINERALS						
Asbestos: e/						
Concentrate, (3% to 8% marketable fiber)		80,000 e/	80,000	65,000 e/	65,000	86,200
Marketable fiber e/		4,500	4,500	4,500 r/	4,500	4,300
Barite		226,377	139,000 r/ e/	150,000 r/	150,000	181,174
Boron, borax e/		500	500	500	500	420
Cement, hydraulic e/	thousand tons	16,000	16,000	16,300	16,500	15,200
Clays:						
Bauxite and refractory clays e/		220,000	220,000	220,000	220,000	215,000
Bentonite		53,667	71,759 r/	54,789 r/	85,000 r/	105,300 3/
Other:						
Industrial clays e/		250,000	300,000	250,000	300,000	350,000
Kaolin		227,650 r/	265,591 r/	250,000 e/	350,000 r/ e/	510,000
Total		477,650 r/	565,591 r/	500,000 e/	650,000 e/	860,000
Diatomite e/		85 3/	90	90	90	90
Feldspar		76,873 3/	75,000	80,000 r/ e/	106,000 r/ 3/	125,000 3/

See footnotes at end of table.

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TABLE 1--Continued
IRAN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996 e/	1997 e/
INDUSTRIAL MINERALS--Continued						
Fluorspar, fluorite e/		10,000	22,204 r/	20,163 r/	20,000 r/	20,000
Gemstones, turquoise e/	kilograms	5,000	5,000	5,000	5,000	5,000
Gypsum	thousand tons	7,799	8,430	8,230	8,570 3/	8,900
Industrial or glass sand (quartzite and silica) e/		932,000 3/	950,000	1,000,000 e/	1,000,000	1,000,000
Lime e/	thousand tons	650	650	650	650	650
Magnesium compounds e/		49,424 3/	45,000	55,000	55,000	55,000
Mica e/		1,224 3/	3,000	3,000	3,000	3,000
Nitrogen:						
N content of ammonia		722,500	696,200	715,400	882,000 r/	879,800 3/
N content of urea		387,100	400,000 r/	421,800	552,900	610,500 3/
Perlite e/		6,000	6,000	6,000	6,000	6,000
Pigments, mineral, natural iron oxide e/		2,500	2,500	2,500	2,500	2,500
Pumice and related volcanic materials e/		185,000 3/	200,000	200,000	200,000	200,000
Salt		988,700	1,050,000	936,000	1,000 e/	1,180
Sodium compound, caustic soda e/		15,000	15,000	15,000	15,000	15,000
Stone:						
Construction and building, crushed, n.e.s. e/	thousand tons	4,500	4,800	4,800	4,800	4,800
Dimension and decorative: e/						
Granite	do.	30	20	20	20	20
Marble:						
Blocks	do.	3,200	4,500	4,500	4,500	4,500
Crushed	do.	400	450	450	450	450
Slabs	do.	20	50	50	50	50
Travertine:						
Blocks	do.	300	500	500	500	500
Crushed and slabs	do.	60	70	70	70	70
Total	do.	4,010	5,590	5,590	5,590	5,590
Dolomite	do.	173	200 e/	243	200	200
Limestone	do.	26,000	28,000 e/	28,000 e/	28,000	28,000
Strontium, celesite e/		20,000	20,000	20,000	20,000	20,000
Sulfates, natural:						
Aluminum potassium sulfate (alum) e/		12,000	12,000	12,000	12,000	12,000
Sodium sulfate		280,000 3/	280,000	280,000	315,000 r/ 3/	480,000
Sulfur: e/						
Byproduct of petroleum and natural gas		750,000	830,000	840,000	840,000	850,000
Byproduct of metallurgical processing, S content of acid		50,000	50,000	50,000	50,000	50,000
Total		800,000	880,000 3/	890,000	890,000	900,000
Talc		18,000	18,000 e/	20,000 e/	20,000	20,000
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	1,665	1,720	1,640 r/ 3/	1,840 r/ 3/	1,750
Coke e/	do.	600	700	700	700	700
Gas, natural:						
Gross	million cubic meters	60,000	61,000	79,600 r/	86,000 3/	89,000
Dry	do.	27,100	28,200	36,600 r/	39,077 r/	43,000
Natural gas plant liquids	thousand 42-gallon barrels	23,300	23,500	23,500 e/	23,500 e/	22,000
Petroleum:						
Crude	do.	1,332,000	1,325,000	1,329,700	1,345,390 r/	1,337,360 3/
Refinery products: e/						
Liquefied petroleum gases	do.	20,000	23,000 3/	24,000	24,000	24,000
Motor gasoline	do.	50,000	51,500	54,425 r/ 3/	54,500	54,500
Jet fuel	do.	8,000	9,200 3/	9,000	9,000	9,000
Kerosene	do.	32,000	34,400	36,000 r/	36,000 r/	36,000
Distillate fuel oil	do.	100,000	107,600 3/	104,828 r/ 3/	108,000 r/	108,000
Residual fuel oil	do.	100,000	103,000	93,367 r/ 3/	95,000 r/	95,000
Other	do.	40,000	35,800 3/	45,000 r/	43,000	43,000
Total	do.	350,000	364,500	366,620 r/	369,500 r/	369,500

e/ Estimated. r/ Revised.

1/ Table includes data available through October 1, 1998

2/ Data are for Iranian years ending March 21 of that stated, except data for natural gas, plant liquids, and petroleum, which are for Gregorian calendar years.

3/ Reported figure.

4/ Includes gold recovered from the Mouteh gold mine and from the Sar Cheshmeh copper complex.

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THE MINERAL INDUSTRY OF

IRAQ

By Bernadette Michalski

Mineral production—principally cement, hydrocarbons, iron and steel, phosphate rock, salt, and sulfur—was, for the most part, limited to satisfying domestic consumption as a result of the United Nation's (U.N.) trade embargo imposed on Iraq after the 1990 invasion of Kuwait. (See table 1.) In mid-December 1996, crude oil exports authorized under the Oil for Humanitarian Aid Agreement (U.N. Resolution 986) were initiated, thus permitting the sale of Iraqi crude oil, valued at $2 billion, during a 6-month period divided into two 90-day segments. Iraq interrupted oil exports in May 1997, and although the U.N. Security Council passed a new resolution on June 8 allowing the plan to continue and repeating the same formula, exports did not resume immediately. The first segment of the second phase of Resolution 986 was in effect between June 8 and September 5, but Iraq refused to resume exports until a dispute involving the U.N. aid distribution plan was resolved. When the second phase of the Agreement finally did get underway in mid-August, only 3 weeks remained in which to take full advantage of the $1 billion export limit in the first segment of the second phase. Therefore, the division into two 90-day segments was waived by the Security Council for the second phase only; this allowed Iraq to realize the maximum $2 billion in exports. A third phase of the Agreement was approved by the U.N. and began on December 5, 1997. As in the first phase, the Agreement authorized Iraq to sell up to $2 billion worth of crude oil during a 6-month period divided into two 90-day segments during each of which no more than $1 billion can be sold. Because crude oil export limits were set by value, weakening prices in 1997 resulted in increased export volumes. (See table 2.) More than one-half of Iraq's crude oil exports were transported through Turkey via the Kirkuk-to-Ceyhan pipeline. Because the pipeline's outlet is to the Mediterranean Sea, most of crude oil delivered to Ceyhan, Turkey, was destined for Europe. The remaining crude oil exports were delivered to the port of Mina al-Bakr on the Arabian Gulf en route to Africa, Asia, Brazil, and the United States. Under Resolution 986, 55 cents of every crude oil export dollar was spent for food and medicine, 35 cents was awarded to the Kuwaiti reparations fund, and the remainder supported the expenses of the U.N. weapons inspectors. In addition to the oil exports permitted under the U.N. Humanitarian Aid Program, Iraq also supplied about 90,000 barrels per day (bbl/d) of crude oil and products to Jordan under U.N. approval. Crude oil was shipped by truck via a 1,000-kilometer desert highway between Baghdad and Amman.

The output of associated natural gas production paralleled crude oil production, increasing gross output by 1.0 billion cubic meters in 1997. About 20% of natural gas output was flared owing to the lack of gas processing facilities. Of the remaining production, about one-third was used in power generation, one-third, by the oil sector, and one-third by other industries. The Turkish Government entered into an agreement with Iraq to build a 10-billion-cubic-meter-per-year (m^3/yr)-capacity natural gas pipeline to Ceyhan from five northeastern fields—Anfal with reserves of 49.9 billion cubic meters; Chemchemal, 61.7 cubic meters; Jaria-Pika, 26.3 cubic meters; Khashm al-Ahmar, 39.9 billion cubic meters; and Mansuriyah, 92.8 billion cubic meters of natural gas reserves. The project is estimated to cost $2.77 billion and will take 2 to 3 years to complete if and when the U.N. sanctions are lifted.

At least 40 international petroleum companies from about 20 countries were actively seeking production-sharing and development contracts with Iraq. France's Total, SA, was negotiating a production-sharing agreement valued at about $3.5 billion for the projected 450,000-bbl/d-capacity Bin Umar Field and a development contract for the Nahr Umar Field. Elf Aquitane, Inc., also of France, plans to develop the shut-in Majnoun Field with a production capacity of 400,000 bbl/d from reserves of 6 billion barrels. Agip of Italy and Repsol of Spain entered into negotiations to develop the Nassiriyah Field (Petroleum Economist, 1998). In March 1997, Iraqi and Russian Government officials signed a contract to develop the West Qurna Field. Projected cost is $5 billion to exploit the field's reserves of 7 to 8 billion barrels. Projected production is 600,000 bbl/d for 23 years; total estimated revenue is approximately $70 billion based on current prices. As in most of Iraq's production-sharing agreements, all appraisal and development costs are borne by the contractor to be recovered from an agreed share of production and the remaining output, to be split between the Government and the contractor in agreed proportions. India's Oil and Natural Gas Commission and Reliance Industries will develop a 14,000-square-kilometer block that is estimated to have reserves of 4 billion barrels. The block includes the Al-Halfaya Field and is expected to have the capacity to produce 220,000 bbl/d of 28° API gravity oil. The China National Petroleum Corp. (CNPC) has a production-sharing agreement to develop the Ahdab Field, which has estimated reserves of 1.4 billion barrels and a projected production capacity of 80,000 bbl/d for a 26-year period. Field development is expected to take 4 years. CNPC is expected to analyze seismic data already collected by Iraq while hoping for U.N. sanctions to be lifted (Oil & Gas Journal, 1997).

The Iraqi Ministry of Oil places total proven crude oil reserves at 112 billion barrels and natural gas reserves at 3.36 trillion cubic meters (Arab Oil and Gas Research Center, 1998).

U.N. sanctions have weighed heavily on Iraq, and although limited crude oil exports were realized during the year, the need remains for repairs and refurbishment of the petroleum export network if exports are to increase. The near-term outlook for the oil market will depend on the expected economic growth, as well as the decisions of oil producers, particularly members of the Organization of Petroleum Exporting Countries. With the exception of limited oil exports in 1997, the U.N. trade embargo, which has remained in place for 7 years, has severely restricted Iraq's economy, particularly the mineral sector, which is largely

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dependent upon foreign capital, equipment, and replacement parts. Should there be a return to normal trade relations, Iraqi oil authorities have given priority to the rehabilitation of existing production facilities, followed by development of already discovered giant fields, and finally the exploration of new acreage in the western desert. Iraq ultimately plans to develop its crude oil production capacity to 6 Mbbl/d. Iraq expects to achieve this goal withing 7 years after the U.N. sanctions are lifted.

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TABLE 1
IRAQ: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Thousand metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
METALS						
Iron and steel, steel crude		300	300	300	300	300
INDUSTRIAL MINERALS						
Cement, hydraulic		2,000	2,000	2,108 r/ 3/	2,100	2,500
Nitrogen, N content of ammonia		500	500	500	500	500
Phosphate rock:						
Beneficiated 3/		800	1,000	1,000	1,000	1,000
Phosphorus pentoxide content		240	300	300	300	300
Salt		300	300	250	250	250
Sulfur, elemental:						
Native, Frasch		250	250	250	250	250
Byproduct 4/		200	225	225	225	225
Total		450	475	475	475	475
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	5,000 r/	5,000 r/	5,000 r/	5,000 r/ 3/	7,000
Dry	do.	3,000 r/	3,000 r/	3,000 r/	3,000 r/ 3/	3,000
Natural gas plant liquids	thousand 42-gallon barrels	10,000	10,000	10,000	10,000	
Petroleum:						
Crude (including lease condensate)	do.	187,000 3/	200,000 3/	205,000 3/	213,000 3/	433,000 3/
Refinery products	do.	160,000	160,000	190,000 r/	190,000 r/	200,000

r/ Revised.
1/Includes data available through September 15, 1998.
2/ In addition to commodities listed, the following also were produced but information is inadequate to reliably estimate output: gypsum for cement, plaster, mortar and other products; limestone for cement (about 1.3 metric tons per metric ton of finished cement), lime, and construction stone; clay and/or shale for cement (about 0.4 metric ton per metric ton of finished cement); other construction materials (e.g., clays for brick and tile, sand and gravel, stone); uranium and fluorine compounds from phosphate rock processing; industrial sand for foundry use and glass manufacture; and clays for ceramics and refractories.
3/ Estimated to contain 30% phosphorous pentoxide.
4/ Presumably from petroleum and natural gas processing.

TABLE 2
IRAQ: CRUDE OIL DESTINATIONS 1997

(Million barrels)

Type crude oil	Europe	United States	Far East	South Africa	Total	Percentage of total
Basrah light, 34.4 API°	--	64.0	34.8	6.4	105.2	43.3
Kirkuk, 37 API°	130.0	7.7	--	--	137.7 1/	56.7
Total	130.0	71.7	34.8	6.4	243.0	100.0
Percent	53.5	29.5	14.3	2.6	100	

1/ Data are rounded to three significant digits; may not add to totals shown.

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THE MINERAL INDUSTRY OF

ISRAEL

By Bernadette Michalski

Israel's indigenous minerals industry is based on the extraction of bromine, magnesium, and potassium-bearing evaporites from the Dead Sea; phosphate rock mining; the manufacture of cement and fertilizers; and the production of minor quantities of crude oil and natural gas. A significant mineral-related industry is the cutting of diamonds and the fabrication of jewelry from imported materials.

The value of worked and unworked diamonds imported in 1996, the latest year for which trade data was available, was $5,078 million. Diamond exports were valued at $6,210 million. For more extensive coverage of the mineral industry of Israel, see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

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TABLE 1
ISRAEL: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996 e/	1997 e/
METALS						
Iron and steel, steel, crude		120,000	180,000	200,000 e/	203,000 r/	203,000
INDUSTRIAL MINERALS						
Bromine: e/						
Elemental		130,000 3/	130,000	130,000	160,000 r/	160,000
Compounds		121,000 3/	121,000	121,000	145,000 r/	150,000
Caustic soda		29,851	32,765	44,961	45,000	45,000
Cement, hydraulic	thousand tons	4,536	4,800	6,204 r/	6,700 r/	6,700
Clays: e/						
Flint clays		40,000 3/	40,000	40,000	40,000	40,000
Kaolin		40,000 3/	40,000	40,000	40,000	40,000
Other		8,500 3/	8,500	8,500	8,500	8,500
Fertilizers materials, manufactured:						
Nitrogenous, N content of ammonia and urea		38,743	50,000 r/ e/	69,700 r/	64,600 r/	56,600 3/
Phosphatic, P content e/		30,363 3/	30,300	33,000	33,000	33,000
Potassic, K content e/		16,007 3/	16,000	17,000	17,000	17,000
Gypsum e/		48,000	48,000	50,000	50,000	50,000
Lime e/		210,000	210,000	210,000	275,000 r/	275,000
Magnesia, Mg content e/		42,223 3/	42,200	42,200	42,200	42,200
Phosphate rock:						
Beneficiated	thousand tons	3,680	3,961	4,063	3,839 r/ 3/	4,047 3/
P_2O_5 content	do.	1,148	1,232	1,264	1,200 r/ 3/	1,250 3/
Potash, K_2O equivalent	do.	1,309	1,259	1,325	1,500 r/ 3/	1,488 3/
Salt, marketed (mainly marine) e/	do.	1,123 3/	1,120	900 r/	800 r/	800
Sand:						
Glass sand		82,700	176,300	222,900 r/	225,000 r/	225,000
Other e/	thousand tons	7,063 3/	7,060	7,060	7,060	7,060
Sodium and potassium compounds, caustic soda		29,851	32,765	32,800 e/	32,800	32,800
Stone e/						
Crushed	thousand tons	31,515	31,500	31,500	31,500	31,500
Dimension, marble	do.	12,000	12,000	12,000	12,000	12,000
Sulfur:						
Byproduct from petroleum e/	do.	60	60	60	60	60
Sulfuric acid e/	do.	130	130	130	130	130
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural: e/						
Gross	thousand cubic meters	19,800	21,300 r/	21,300 r/	20,000 r/	20,000
Dry	do.	19,800	21,300 r/	21,300 r/	20,000 r/	20,000
Petroleum:						
Crude	thousand 42-gallon barrels	56	37	36	36	36
Refinery products:						
Gasoline	do.	18,500	19,800	20,500 r/	20,600 r/	20,800
Kerosene	do.	5,300	5,200	9,400 r/	9,400 r/	9,500
Distillate fuel oil	do.	21,000	20,500	23,400 r/	23,500 r/	23,800
Residual fuel oil	do.	28,500	28,000	24,500 r/	24,500 r/	25,000
Other	do.	13,200	13,000	13,100 r/	13,200 r/	13,300
Total	do.	86,500	86,500	90,900 r/	91,200 r/	92,400

e/ Estimated. r/ Revised.

1/ Table includes data available through May 15, 1998.

2/ In addition to the commodities listed, a variety of other crude construction materials are produced, but available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

JORDAN

By Bernadette Michalski

Industrial minerals, including construction raw materials, are the major mineral commodities mined in Jordan. The country ranks sixth in global phosphate rock production and seventh in potash. Although the bulk of mineral production is exported, increasing quantities of phosphate and potash are consumed in the domestic manufacture of fertilizers. Limestone was consumed by the domestic cement industry and in the production of soda ash in the Dead Sea Chemical Industries' Complex.

In addition to the above mentioned minerals, Jordan was also a significant regional cement producer. *(See table 1.)*

The Jordan Natural Resources Authority (NRA) was the Government agency responsible for all activities related to the exploration and development of minerals and mineral fuels. The exploitation of the major mineral commodities of Jordan—cement, kaolin, phosphates, and potash—were all controlled by parastatals. Aggregates, basalt, calcium carbonate, dimensional stone, and glass sand were produced by private-sector firms. Foreign investors may own all or part of a business or project in most economic sectors; however, foreign ownership in the mining sector is limited to a maximum of 50%. Foreign entities were given the same rights under the law as Jordanian investors and may fully repatriate capital and profits. Fixed assets of a project and spare parts imported for the project were tax-exempt. The corporate income tax was 15% for companies in mining and 25% for companies in trade and transport.

Bulk phosphate and fertilizer exports accounted for about one-third of the nation's total export revenues. Other exports included aluminum can scrap, all of which were shipped to the United States. Virtually all petroleum requirements were imported from Iraq under a series of agreements that have been renewed annually since 1991 with the approval of the United Nations' Sanctions Committee. During this period, imports of crude oil from Iraq ranged from 40,000 to 60,000 barrels per day (bbl/d) and petroleum products between 17,000 and 25,000 bbl/d. All deliveries were made by tank truck.

The Arab Aluminium Industry Company (ARAL) commissioned two new extrusion presses in 1997, doubling its aluminum extrusion capacity to nearly 12,000 metric tons per year (t/yr), enabling the company to increase its exports to other Middle Eastern countries and Africa. Jordan's internal market had no price controls on aluminum which is sold based on London Metal Exchange prices plus a local premium. ARAL had a 10,000-t/yr capacity remelt foundry and received its primary ingot from Egypt's Egyptalum and Bahrain's Aluminium Bahrain.

Sharif Metals Trading & Smelting Co. of Jordan invested $500,000 in the construction of a secondary aluminum smelter with a potential capacity of 7,000 t/yr. The smelter was expected to enter production in 1998.

Enhanced gold concentrations in felsic volcanic rocks in Wadi Araba were identified by the NRA. The structure has been subdivided into the Aqaba Complex, comprised of a sequence of schistose and gneissic metamorphic remnants and plutonic rock, and the Araba Complex, made up of alkaline, rhyolitic lavas, and subvolcanic intrusions.

The Jordan Magnesia Company was established in 1997 as a subsidiary of the Jordan Dead Sea Industrial Company for the purpose of building and operating a magnesium oxide complex adjacent to the Dead Sea at Safi, about 120 kilometers (km) south of Amman. Final engineering designs place capacity at 50,000 t/yr of high-quality dead-burned magnesium oxide for the refractory industry and 10,000 t/yr of caustic calcined magnesia and magnesium hydroxide for the chemical and plastics industries. Construction was expected to begin in the first quarter of 1999 with production beginning a year later. The Jeddah-based Islamic Development Bank provided a $28 million loan for the estimated $90 million project (Middle East Economic Digest, 1998).

The Indo-Jordan Chemicals Company. Ltd. (IJC) was a joint venture among Southern Petrochemicals Industries Corporation of India (SPIC) (52.2%), Jordan Phosphate Mines Company (JPMC) (34.8%), and Arab Investment Company of Saudi Arabia (13%). The company commissioned a $170 million fertilizer plant in late June 1997. The 690,000-t/yr-sulfuric acid unit used the Monsanto Enviro-Chem's double conversion/double absorption process. The 220,000-t/yr-capacity phosphoric acid unit used the HydroAgri International Licensing hemihydrate process, designed to handle multiple grades of phosphate rock with minimal consumption of water. Phosphate rock feedstock for the plant was supplied from the Ash Shidiya Mine. By the close of 1997, 130,000 metric tons (t) of phosphoric acid valued at $23.6 million was shipped to SPIC's plants in India (Middle East Economic Digest, 1998).

The Nippon Jordan Fertilizer Company commissioned a compound fertilizer plant in May 1997 with a capacity to produce 300,000 t/yr of diammonium phosphate (DAP) and nitrogen-phosphorus-potassium (NPK) compound fertilizer. By yearend, 130,000 tons of DAP and NPK was produced. Of this number, 110,000 t valued at $21 million was sent to Japan.

The IJC plant and the Nippon Jordan Fertilizer Company plant were supplied phosphates by JPMC whose production rose by 12% in 1997. *(See table 1).*

Norsk Hydro and JPMC are planning the construction of a US$500 million fertilizer complex, including a 440,000-t/yr-capacity phosphoric acid plant and an NPK fertilizer complex of 1- million-metric-tons per year (Mt/yr) capacity. Operations are expected to start in 2000. Norsk Hydro and other foreign investors will hold 60% of the venture, and the remainder will be owned by a group of Jordanian companies including JPMC and Arab Potash.

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Jordan's infrastructure is sufficient to support current mining operations. Railroads within Jordan consist of 619 km of 1.05-meter-gauge single track. Crude oil pipelines within the country totaled 209 km. Primary export terminals are at the port of Aqaba, where potash storage capacity is about 160,000 t.

Encouraged by substantial phosphate rock and potash reserves, the Government sought value-added opportunities with emphasis on the development of local processing facilities. The 1994-98 government plan called for phosphate production to increase to 1 Mt/yr of which 30-40% were to be processed within the country.

Plans for the construction of a regassification plant in Aqaba using liquefied natural gas from Qatar were abandoned. As an alternative, Amoco Corporation of the United States and the Tractebel Group of Belgium entered into agreement with the Ministry of Energy and Mineral Resources to manage the sale and distribution of natural gas throughout Jordan, including responsibility for the purchase, transport, and marketing of the natural gas. The companies undertook a feasibility study to determine the viability of using Egypt as the source of natural gas delivered via a pipeline across the Gulf of Aqaba (Middle East Economic Digest, 1997). The natural gas will be used in the fertilizer industry and for power generation.

The NRA has entered into a memorandum of understanding with Royal Dutch Petroleum Company to investigate the potential development of oil shale resources which have been estimated by the NRA to be 40 billion metric tons (Petroleum Economist, 1998).

Anadarko Jordan Co., a unit of Anadarko Petroleum Corp. of the United States, began test drilling in September on the 1.7-million-hectare Safawi block in northeastern Jordan. Anadarko was awarded the block in 1996 under a 25-year production-sharing accord in which Anadarko agreed to spend at least $20 million. This included a minimum of $5 million that will be spent during the first 2.5 years of exploration.

M.W. Kellogg Co. of the United States was selected by the Jordan Petroleum Refinery Co. to conduct a detailed feasibility study on expanding the Zerka Refinery capacity to enable the country to meet demand for refined products through 2010.

The NRA estimated Jordanian phosphate rock reserves to be 1 billion tons. Potash was obtained primarily from Dead Sea brines. The World Bank estimated that of the dissolved solids contained in the Dead Sea, 33 billion tons was sodium chloride and magnesium chloride and about 2 billion tons was potassium chloride.

Jordan's strengthening economy, privatization program, strategic commitment to infrastructure development and favorable investment reforms may encourage additional interest in mineral industry development. Government investment incentives included reduced taxes and profit repatriation. The Jordanian-U.S. treaty eliminated performance requirements and grants most-favored-nation status to U.S. firms. The economic restructuring program supported by the International Monetary Fund succeeded in curbing inflation and fostered a 5.2% economic growth in 1996 and a 6.5% growth in 1997. In spite of these improving conditions, the uncertainties of the Middle East peace process cause hesitation in many potential investors.

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Major Source of Information

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TABLE 1
JORDAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
Carnalite		NA	NA	1,346	1,400 e/	1,400
Cement, hydraulic	thousand tons	6,400	6,400 e/	3,508 r/	3,415 r/	3,251 2/
Feldspar e/		--	--	7,341	7,000	7,000
Gypsum		194,981	193,000 e/	166,575 r/	169,000 r/	170,000
Iron and steel, steel, crude e/		30,000	30,000	30,000	30,000	30,000
Kaolin		47,174	47,200 e/	50,000 e/	65,998	67,000
Lime		7,267	7,270 e/	8,888 r/	10,000 r/ e	10,000
Natural gas	million cubic meters	310	340	350	350 e/	350
Petroleum:						
Crude	thousand 42-gallon barrels	11	36 r/	36 r/	36 r/	36
Refinery products:						
Liquefied petroleum g	do.	1,500 2/	1,500	1,500	1,500	1,500
Gasoline	do.	4,100	4,130 e/	4,100 r/	4,300 r/	4,300
Jet fuel	do.	1,600	1,650 e/	1,800 r/	1,900 r/	1,900
Kerosene	do.	2,300	2,350 e/	1,800 r/	2,000 r/	2,000
Distillate fuel oil	do.	5,500	6,050 e/	6,570 r/	6,000 e/	6,000
Residual fuel oil	do.	5,240	6,390 e/	6,900 r/	7,000 r/	7,000
Other	do.	2,350 2/	2,000	2,200	2,200	2,200
Total	do.	22,590	24,070 e/	24,870 r/	24,900 r/	24,900
Phosphate:						
Mine output:						
Gross weight	thousand tons	3,565 r/	4,218	4,983	5,424 r/	6,075 2/
P2O5 content	do.	1,176 r/	1,399	1,655	1,790 r/	2,005 2/
Phosphatic fertilizers		490,788 r/	749,700	730,000 r/	729,000 r/	576,000 2/
Phosphoric acid		NA	NA	347,984	325,000	323,000 2/
Potash:						
Gross weight	thousand tons	1,511	1,550	1,780 r/	1,765 r/	1,417 2/
K2O equivalent	do.	822	930	1,075 r/	1,059 r/	849
Salt		26,000	26,000	21,500 r/	50,000 r/ e	50,000
Stone:						
Limestone		5,336 2/	5,340	5,340	5,340	5,350
Marble		112,250 2/	112,000	112,000	112,000	112,000

e/ Estimated. r/ Revised. NA Not available.
1/ Table includes data available through June 1, 1998.
2/ Reported figure.

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THE MINERAL INDUSTRY OF

KUWAIT

By Bernadette Michalski

The preponderant sector of the mineral industry continues to be the production and refining of crude oil. In 1997, the oil industry accounted for about 52% of the gross domestic product, generated nearly 95% of export revenues, and provided 90% of Government revenues. With the commissioning of the nation's first petrochemical complex in 1997, the production for export of such value-added commodities as ammonia and urea was expanded to include ethylene-based petrochemicals.

Government Policies and Programs

Kuwait's many investments, which included participation in foreign petroleum exploration, acquisition of foreign petroleum refining and distribution networks, and participation in overseas petrochemical facilities, have fostered an economy with globally dispersed assets. Under its privatization plan, the Kuwaiti Government expects to recover $2.68 billion in equity distributed among 62 companies and by privatizing services that were being subsidized or provided free by the Government. These services included electric power production, transportation, and communications. The control of all oil and gas production, refining, transportation, and marketing in Kuwait continued to remain firmly under Government control.

Environment

The environmental damage resulting from oil seeping onto large areas of the ground and into the waters of the Gulf as a result of the invasion and occupation of Kuwait by Iraq in 1990-1991 is not yet fully understood. Kuwait's environmental damage as a result of the Gulf War has been assessed at $16.3 billion (Washington Times, 1998).

Production

The Organization of Petroleum Exporting Countries (OPEC) continued Kuwait's crude oil production quota at 2 million barrels per day (Mbbl/d) for 1997—the same level since the fourth quarter of 1993. Kuwait's crude oil production averaged just above 2 Mbbl/d, including about 250,000 barrels per day (bbl/d) from the Partitioned Zone shared with Saudi Arabia. *(See table 1.)*

Trade

Total exports, virtually all hydrocarbon related, were valued at $13.7 billion in 1997. Total imports, principally vehicles and other consumer goods, were valued at $7.5 billion. The leading market for Kuwait's petroleum was Japan, which imported 557,000 bbl/d of crude oil and petroleum products combined. European imports averaged 249,000 bbl/d; much of the crude oil, however, was delivered to Kuwait-owned European refineries, and the resulting products were marketed in Europe through the Kuwait-owned distribution system. The United States imported 252,000 bbl/d of mostly crude and unfinished oil from Kuwait, accounting for 2.4% of the U.S. petroleum imports for the year (Energy Information Administration, 1998).

Structure of the Mineral Industry

The Government of Kuwait imposed few restrictions on trade or financial flows and placed considerable emphasis on development of the economy by the private sector. The petroleum and natural gas extraction and processing industries, however, were under Government control. *(See table 2.)* The Supreme Petroleum Council comprised of the Prime Minister, six other Government ministers, and six representatives from the private sector who are appointed by the Emir for 3-year terms. The Kuwait Petroleum Corporation (KPC) reports directly to the Supreme Petroleum Council and operates through a number of specialized subsidiaries. These include Kuwait Oil Co. (KOC), which is responsible for domestic exploration and production; Kuwait National Petroleum Co. (KNPC), which is responsible for domestic refining and distribution; Kuwait Foreign Petroleum Exploration Co. (KUFPEC), which is responsible for upstream activities outside Kuwait; Kuwait Petroleum International (KPI), which is responsible for overseas refining and distribution; Kuwait Oil Tanker Co. (KOTC), which is responsible for maritime transport; and the Petrochemical Industries Co. (PIC), which is responsible for petrochemical development, production, and marketing.

Despite the liquidation of several billion dollars in assets since the Iraqi invasion, Kuwait retained substantial worldwide investments, including an extensive petroleum refining and distribution network in Western Europe, as well as downstream investments in Eastern Europe, India, and Southeast Asia.

Commodity Review

Metals

Arabian Light Metals Co. operated a 5,000-metric-ton-per-year (t/yr)-capacity aluminum extrusion plant. The company used billet imported from Bahrain, Dubai, and Egypt.

The construction of a 300,000-t/yr-capacity steel rebar mill was under consideration as a joint venture between private Kuwaiti investors and the National Iranian Steel Company (NISCO). The proposed $80 million plant is to be supplied with direct reduction iron from NISCO plants in Iran. Kuwait consumes about 500,000 t/yr of steel rebars (Middle East Economic Digest, 1998).

Industrial Minerals

Cement.—The heavy construction demands resulting from

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damages related to the Gulf War have ended, and any further construction programs are within the limits of the 2-million-ton-per-year (Mt/yr) cement mill capacity. The Kuwaiti cement industry imports all its clinker requirements.

Fertilizers.—PIC operated the Shuaybah Fertilizer Complex, which had the capacity to produce about 1 Mt/yr of ammonia and 800,000 t/yr of urea. The bulk of the complex's urea output is exported to China, Japan, and the Philippines. Ammonia exports, by order of volume, are destined for India, the Republic of Korea, Taiwan, Jordan, Tunisia, Turkey, Spain, and Greece.

Mineral Fuels

Natural Gas.—Production consisted solely of associated natural gas requiring KOC to maximize natural gas recovery at its oilfields to satisfy domestic demand. The utilization rate exceeded 85% in 1997. Kuwait's natural gas gathering network delivered the gas to three gathering stations distributed in different regions within the country. From each of these locations, it was piped to Shuaybah for fractionation. Associated natural gas from the Raudhatain and the Sabiriya Fields near the northern border with Iraq was processed in northern Kuwait, and a mixed liquids stream was delivered by pipeline to the fractionator at Shuaybah. Natural gas from the Minagish, the Umm Gudair, and the South Umm Gudair Fields, near the western border with Saudi Arabia, flowed as wet gas to the processing plant at Shuaybah. Natural gas from the Burgan complex, which included the Maqwa-Ahmadi Fields, was processed at two field recovery plants. The recovered liquids were then delivered by pipeline to Shuaybah for fractionation. The gas system has the capacity to process associated gas from as much as 3 Mbbl/d of oil production (current production is only 2 Mbbl/d), stripping liquids for export, and using dry gas for Kuwait's domestic needs–fuel for electric power and feedstock in fertilizer and petrochemical production. With crude oil production limited by OPEC quota, Kuwait experienced a natural gas shortage in the last quarter of 1997 requiring KPC to reduce the volume of deliveries to power stations and desalination plants so that the new petrochemical complex could be supplied with feedstock. The Ministry of Electricity and Water was required to substitute heavy fuel for natural gas in some of its powerplants.

Petroleum.—Production.—The bulk of Kuwait's 2-Mbbl/d output was derived from the Burgan complex. About 80% of the crude oil produced in Kuwait had a low to medium gravity and a high sulfur content. It is blended into a single stream–Kuwait Export (31° API 2.5% S).

The country's sustainable crude oil production capacity was about 2.5 Mbbl/d, including 275,000 bbl/d in the Partitioned Zone. The Government planned to augment sustainable crude oil production capacity to 3 Mbbl/d by 2000 and a further increase to 3.5 Mbbl/d by 2005. No significant expansion was planned for the Burgan complex, which accounted for more than one-half of the nation's sustainable crude oil capacity, or about 1.6 Mbbl/d. The Raudhatain Field capacity will be expanded from 250,000 to 550,000 bbl/d, The capacities of the Minagish Field and the Umm Gudair Field will be increased from 60,000 to 210,000 bbl/d and from 57,000 to 270,000 bbl/d, respectively. Additional capacity expansion was expected to result from the development of the light crude oil reservoirs in the deep Marat, Naja, and Sarjelu Formations under the main oilfields.

Refining.—Nearly one-half of Kuwait's crude output was refined domestically. The post-Gulf War refinery reconstruction program elevated total refining capacity to 886,000 bbl/d from the pre-War 770,000-bbl/d capacity. Domestic consumption of refined products averaged about 120,000 bbl/d; about 750,000 bbl/d was available for export, some of which was absorbed by KPC's retail and wholesale European distribution network. In addition to domestic refineries, KPC acquired equity in overseas refining centers. KPC's refining equities in Europe were the 75,000-bbl/d-capacity Europort refinery in Rotterdam and a 50% share in the 300,000-bbl/d-capacity Milazzo refinery in Sicily. KPC closed its 59,000-bbl/d Stignaes refinery in Denmark in 1997. KPC pursued joint-venture refineries in China, India, Pakistan, and Thailand with the objective of eventually attaining 400,000 bbl/d of refining capacity in Asia. The proposed joint venture with the Indian Oil Corp. to construct a 250,000-bbl/d refinery in the State of Orissa was denied planning permission by Indian authorities in December 1997. By yearend, KPC signed an agreement with Qilu Petrochemicals Company of China to finance a 120,000-bbl/d expansion of its 160,000-bbl/d refinery in Shandong Province in eastern China. According to the agreement, KPC will supply the crude oil feedstock and technical assistance.

Petrochemicals.—Equate, with equity held by PIC (45%), Union Carbide Corp. of the United States (45%), and the Bubiyan Investment Co. of Kuwait (10%), inaugurated Kuwait's first petrochemical complex in November 1997. The $2 billion Shuaybah complex has the capacity to produce 650,000 t/yr of ethylene, 450,000 t/yr of high-density and linear low-density polyethylene, and 350,000 t/yr of ethylene glycol. Most of the petrochemical output will be exported, principally to Southeast Asia. At yearend, a 100,000-t/yr-capacity polypropylene plant, owned by PIC, came on-stream and was scheduled to consume 6,000 t/yr of ethylene feedstock supplied by the Shuaybah complex.

Reserves

As of January 1, 1998, Kuwait's proven reserves of crude oil were officially estimated by KOC to be 96.5 billion barrels, including 2.5 billion barrels representing Kuwait's share of the Partitioned Zone reserves. Kuwait enjoys a reserve-to-production ratio of 126 years. The bulk of crude oil reserves were located in the Burgan complex, containing about 65 billion barrels.

Natural gas reserves were 1,400 billion cubic meters. The reserves were based entirely on associated natural gas because intensive exploration programs during the past decade uncovered no nonassociated gas reservoirs (Arab Petroleum Research Center, 1998).

Infrastructure

The crude, product, and natural gas pipeline network supporting petroleum production totals 390 kilometers. KOC operated all crude oil and natural gas lines, and KNPC operated all product pipelines. In 1997, combined electricity generating capacity was 6,900 megawatts (MW) from four powerplants. The Ministry of Electricity and Water projected power consumption levels at 9,300 MW by 2000. To meet the requirements, a 2,400-MW thermal power station at Al-Sabiyah was scheduled to be fully operational

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by that time.

Outlook

Increased refining capacity and petrochemical production affords Kuwait a stronger position in value-added products. Joint-venture refining projects in Asia are emerging and should provide additional secure outlets for Kuwait's oil in the future–particularly as Kuwait Export Crude can be processed only by refiners with adequate desulfurization capacity. Proposed aluminum and steel plants, however, will require expanded power generation. The availability of associated natural gas as feedstock for the powerplants is dependent upon an increase in Kuwait's crude oil production quota by OPEC. A 10% increase in production quotas is anticipated in 1998. Should the availability of natural gas not keep pace with power requirements, it may be necessary to resort to higher priced fuel oil as feedstock.

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Major Sources of Information

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TABLE 1
KUWAIT: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Chlorine		25,000	35,000	50,000	50,000 e/	50,000 e/
Cement e/	thousand tons	500	1,000 r/	1,950 r/	2,000 r/	2,000
Clay products, nonrefractory, sand lime bricks e/	cubic meters	100,000	100,000	100,000	100,000	100,000
Lime, hydrated and quicklime e/		35,000	35,000	35,000	35,000	35,000
Natural gas: 2/						
Gross	million cubic meters	5,170	7,560	10,870	10,890 r/	10,900
Dry	do.	4,470	5,970	9,280	9,300 r/	9,250
Natural gas liquids e/	thousand 42-gallon barrels	40,000 3/	42,000 3/	45,000	45,000	45,000
Nitrogen:						
N content of ammonia		317,000	320,000	492,800 r/	411,900 r/	432,000
N content of urea		292,800	324,100	390,800	356,300	348,500
Petroleum:						
Crude 2/	thousand 42-gallon barrels	683,300	742,000	752,265	743,047 r/	732,574
Refinery products:						
Gasoline, motor	do.	10,183	21,316	16,170	13,874 r/	15,475
Kerosene	do.	16,315	45,100	49,494	44,202 r/	49,303
Distillate fuel oil	do.	43,360	90,702	88,914	86,742 r/	96,754
Residual fuel oil	do.	72,817	88,290	66,940	11,075 r/	12,353
Other	do.	21,316	40,150	78,402	52,067 r/	58,882
Total	do.	163,991	285,558	299,920	207,960 r/	232,767
Salt		40,863 r/	36,897 r/	37,038 r/	100,000 e/	100,000 e/
Sodium and potassium compounds, caustic soda		25,000	30,000	60,000	78,000 r/	78,000 e/
Sulfur:						
Elemental, petroleum byproduct		175,000	200,000	559,000	595,000 r/	664,000
Sulfuric acid e/		5,000 3/	5,000	10,000	10,000	10,000

e/ Estimated. r/ Revised.
1/ Table includes data available through November 15, 1998.
2/ Includes Kuwait's share of production from the Partitioned Zone.
3/ Reported figure.

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TABLE 2
KUWAIT: STRUCTURE OF THE MINERAL INDUSTRY FOR 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of facilities	Annual capacity
Caustic soda		Petrochemical Industries Co. (Government, 100%)	Shuaybah	30
Chlorine		do.	Shuwaikh	27
Do.		do.	Shuaybah	21
Nitrogen:				
Ammonia		do.	do.	1,100
Urea		do.	do.	900
Petroleum, crude	million barrels	Kuwait Oil Co. (Government, 100%)	Burgan	550
Do.	do.	do.	Raudhatain	95
Do.	do.	do.	Sabiriya	58
Do.	do.	do.	Ahmadi	20
Do.	do.	do.	Minagish	25
Do.	do.	do.	Umm Gudair	25
Do.	do.	do.	Maqwa	25
Do.	do.	do.	Bahra	15
Do.	do.	do.	Abdali	9
Do.	do.	do.	Ratqa	5
Do.	do.	Wafra Oil Co. (Saudi Arabian Texaco, 50 %; Kuwait Oil Co., 50%)	Wafra	100
Do.	do.	do.	South Fuwaris	2
Do.	do.	do.	South Umm Gudair	10
Do.	do.	Arabian Oil Co. (Japanese Petroleum Trading Co., 80%; Saudi Arabia, 10%; Kuwait, 10%)	Khafji	100
Do.	do.	do.	Hout	10
Petroleum, refinery products	do.	Kuwait National Petroleum Co. (Government, 100%)	Mina Al-Ahmadi	159
Do.	do.	do.	Shuaybah	72
Do.	do.	do.	Mina Abdulah	93
Petrochemicals:				
Ethylene		Equate Petrochemical Complex (Petrochemical Industries (Co., 45%; Union Carbide Corp., 45%, Bubiyan Investment Co., 10%)	Shuaybah	650
Polyethylene		do.	do.	450
Ethylene glycol		do.	do.	350

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TABLE 3
KUWAIT: EXPORTS OF MINERAL COMMODITIES IN 1997 1/

(Metric tons unless otherwise specified)

Commodity		Total	Destinations	
			United States	Other (principal)
METALS				
Alkali metals		1	--	All to Yemen.
Aluminum metal including alloys, semimanufactures		99	--	Saudi Arabia 57; Bahrain 35; Egypt 5.
Copper metal including alloys, semimanufactures		1	--	All to Oman.
Gold metal including alloys, unwrought and partly wrought	kilograms	396,936	--	United Arab Emirates 300,936; India 86,000; Bahrain 10,000.
Iron and steel, metal:				
Scrap		188,296	--	India 149,467; Pakistan 34,483; Lebanon 692.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		367	--	Bahrain 137; Lebanon 93; Saudi Arabia 55.
Clad, plated, coated		701	--	Egypt 494; United Arab Emirates 99; Saudi Arabia 37.
Of alloy steel		33	32	Egypt 1.
Bars, rods, angles, shapes, sections		386	--	Saudi Arabia 144; Bahrain 139; United Arab Emirates 66.
Wire		167	--	Saudi Arabia 56; United Arab Emirates 46; Iran 45.
Tubes, pipes, fittings		1,485	1	Saudi Arabia 751; United Arab Emirates 337; Oman 111.
Zinc metal including alloys, unwrought	value, thousands	$1	--	All to Saudi Arabia.
INDUSTRIAL MINERALS				
Abrasives, n.e.s., grinding and polishing wheels and stones		3	--	All to United Arab Emirates.
Cement		18	--	Do.
Diamond, natural, gem, not set or strung	value, thousands	$588	$407	United Kingdom $181.
Fertilizer materials:				
Crude, n.e.s.		20	--	All to Lebanon.
Manufactured:				
Ammonia		100,130	--	India 65,000; Republic of Korea 15,000; Hong Kong, China 10,000.
Nitrogenous		775,881	--	India 411,500; China 188,500; Philippines 58,000.
Unspecified and mixed		2	--	All to United Arab Emirates.
Mica, worked including agglomerated splittings		652	--	United Arab Emirates 602; Saudi Arabia 50.
Precious and semiprecious stones other than diamond, natural	value, thousands	$17	--	All to India.
Salt and brine		3,183	18	Saudi Arabia 3,015; Lebanon 44; United Arab Emirates 42.
Stone, sand and gravel:				
Dimension stone, worked		264	--	Qatar 94; Lebanon 82; United Arab Emirates 43.
Gravel and crushed rock		22	--	All to Saudi Arabia.
Sulfur:				
Elemental, colloidal, precipitated, sublimed		579,000	--	India 237,000; Morocco 175,000; Tunisia 127,000.
Sulfuric acid		42	--	All to Saudi Arabia.
Other, crude		212	--	United Arab Emirates 98; Saudi Arabia 81; Kazakhstan 21.
MINERAL FUELS AND RELATED MATERIALS				
Coal, all grades including briquets		3	--	All to Bahrain.
Petroleum:				
Crude	thousand metric tons	57,300	--	Unspecified.
Refinery products:				
Liquefied petroleum gas	do.	3,462	--	Do.
Gasoline		222,914	--	Do.
Kerosene and jet fuel	thousand metric tons	8,292	--	Do.
Distillate fuel oil	do.	12,400	--	Do.
Lubricants		3,521	2	India 1,882; Pakistan 652; Qatar 163.
Residual fuel oil	thousand metric tons	7,293	--	Unspecified.
Bitumen and other residues		20	--	All to United Arab Emirates.
Bituminous mixtures		112	--	United Arab Emirates 80; Qatar 33.
Petroleum coke		827,000	535,000	India 140,000; Egypt 110,000; Turkey 22,000.

1/ Table prepared by Glenn J. Wallace, U.S. Geological Survey.

Source: United Nations Statistical Office (microfiche).

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TABLE 4
KUWAIT: IMPORTS OF MINERAL COMMODITIES IN 1997 1/

(Metric tons unless otherwise specified)

Commodity		Total	Sources	
			United States	Other (principal)
METALS				
Alkali metals		436	--	Germany 340; Italy 37; Saudi Arabia 20.
Aluminum:				
Oxides and hydroxides		138	--	United Kingdom 99; Japan 38.
Metal including alloys, semimanufactures		22,672	1,544	Bahrain 12,398; France 943; Saudi Arabia 817.
Copper metal including alloys, semimanufactures		13,221	265	Saudi Arabia 9,218; United Kingdom 1,593; Greece 1,213.
Gold metal including alloys, unwrought and partly wrought	thousand kilograms	13,652	--	Switzerland 9,465; South Africa 2,910; Germany 875.
Iron and steel, metal:				
Scrap		181	--	All from Germany.
Pig iron, cast iron, related materials		702	--	All from United Kingdom.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		55,093	178	South Africa 9,252; Ukraine 5,581; Germany 5,331.
Clad, plated, coated		75,850	581	Germany 21,874; Japan 12,128; South Africa 10,166.
Of alloy steel		833	44	Japan 293; France 143; United Kingdom 91.
Bars, rods, angles, shapes, sections		482,445	375	Turkey 201,023; Saudi Arabia 159,655; Qatar 56,342.
Wire		12,964	24	Saudi Arabia 7,397; China 2,880; India 575.
Tubes, pipes, fittings		151,892	11,366	Japan 23,540; Germany 18,894; Italy 16,597.
Lead metal including alloys, all forms		6	4	Saudi Arabia 1; United Kingdom 1.
Mercury	value, thousands	$4	--	All from United Kingdom.
Nickel metal including alloys, all forms		1	--	All from India.
Silver metal including alloys, unwrought and partly wrought	value, thousands	$60	--	South Africa $30; United Arab Emirates $30.
Tin metal including alloys, all forms	do.	$2	--	All from Germany.
Zinc metal including alloys:				
Unwrought		337	10	Belgium-Luxembourg 132; Finland 50; Saudi Arabia 47.
Blue powder		162	57	Germany 60; Norway 20; United Kingdom 20.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc.		3	--	All from Syria.
Grinding and polishing wheels and stones		1,127	4	Italy 624; India 391; France 27.
Barite and witherite		219	--	China 150; Finland 19; India 18.
Boron oxides and acids		16	16	
Cement	thousand metric tons	1,867	--	Saudi Arabia 942; India 211; United Arab Emirates 173.
Chalk		84	--	Belgium-Luxembourg 63; Italy 21.
Diamond, natural, gem, not set or strung	value, thousands	$1,448	$25	Italy $615; Belgium-Luxembourg $410; India $192.
Fertilizer materials:				
Crude, n.e.s.		352	--	All from Saudi Arabia.
Manufactured:				
Ammonia		4	--	Do.
Unspecified and mixed		3,481	53	Belgium-Luxembourg 1,088; Germany 409; Italy 309.
Lime		2,960	--	Saudi Arabia 1,616; Oman 1,131; Iran 213.
Mica, worked including agglomerated splittings		6,503	--	Germany 2,725; Saudi Arabia 2,425; United Arab Emirates 1,353.
Precious and semiprecious stones other than diamond, natural	value, thousands	$221	$3	India $72; Thailand $42; Hong Kong, China $31.
Pyrite, unroasted		15,951	--	India 14,404; Iran 1,512; Saudi Arabia 35.
Salt and brine		10,482	133	Saudi Arabia 3,698; Netherlands 3,080; Iran 2,901.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		927,012	--	United Arab Emirates 915,054; Saudi Arabia 11,957.
Worked		224,034	83	Italy 79,867; Syria 71,818; Jordan 25,003.
Gravel and crushed rock		333,143	--	Iran 158,961; United Arab Emirates 80,804; Italy 54,426.
Sand other than metal-bearing		10,329	202	Saudi Arabia 8,030; United Arab Emirates 382; Norway 360.
Sulfur:				
Dioxide		11	--	All from Germany.
Sulfuric acid		3,437	(2/)	Saudi Arabia 1,950; Bahrain 1,455; China 25.
Talc, steatite, soapstone, pyrophyllite		5,066	--	Germany 3,496; Netherlands 847; Sri Lanka 322.

See footnotes at end of table.

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TABLE 4--Continued
KUWAIT: IMPORTS OF MINERAL COMMODITIES IN 1997 1/

(Metric tons unless otherwise specified)

Commodity	Total	Sources	
		United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS			
Other, crude	198,963	--	Iran 91,881; Saudi Arabia 45,720; Egypt 44,694.
Carbon black	13	--	Netherlands 6; United Kingdom 5; Spain 1.
Coal, all grades including briquets	439	120	Netherlands 79; Syria 77; Iran 50.
Petroleum refinery products:			
Mineral jelly and wax	36	--	United Kingdom 30; Netherlands 5.
Lubricants	24,169	3,367	United Arab Emirates 11,305; Oman 3,238; Saudi Arabia 2,250.
Bitumen and other residues	66	--	All from Saudi Arabia.
Bituminous mixtures	29,249	420	Saudi Arabia 23,268; Italy 3,388; Greece 743.

1/ Table prepared by Glenn J. Wallace, U.S. Geological Survey.
2/ Less than 1/2 unit.

Source: United Nations Statistical Office (microfiche).

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THE MINERAL INDUSTRY OF

LEBANON

By Bernadette Michalski

In 1997, domestic mineral output was limited to the production of salt and the quarrying of raw materials for the construction industry, particularly limestone and silica for cement manufacture. Until the closure of Lebanon's two refineries, the petroleum-processing industry relied on imported crude oil. The steel industry continues to rely on imported scrap as raw material. Actual production data have not been reported in recent years, but estimates have been made on the basis of the best available information. (See table 1.)

Trade in mineral commodities increased momentum in spite of the fragile stability of the region. Crude oil imports were suspended in mid-1992 with the closure of the Tripoli refinery. Petroleum product consumption has been met entirely through imports since that time. In 1997, petroleum product imports totaled 4.4 million metric tons (about 85,000 barrels per day), representing a volume increase of about 6% compared with that of 1996. Fuel oil imported by the Government for Electricité du Liban accounted for most of the increase. Lebanon's petroleum import costs in 1997 were about $700 million (Arab Petroleum Research Center, 1998).

Lebanon was basically a private-sector-oriented economy. In 1997, most mineral operations in Lebanon remained privately owned, including all cement plants, steel mills, and stone quarries. Petroleum imports, as well as the nation's inactive refineries near Tripoli and Sidon, however, were controlled by the Ministry of Industry and Petroleum. The Zahrani refinery near Sidon suspended operations in mid-1989. The Tripoli refinery supplied about 15% of the nation's petroleum product consumption requirements until mid-1992, when it also suspended operations, largely owing to lack of funds to purchase crude oil. Consideration is being given to the rehabilitation and upgrading of the refinery: the projected cost is $130 million. Any plan to repair the war-damaged Zahrani refinery was abandoned in favor of transforming the Zahrani facility into a petroleum product storage area.

Traco Corp. of Saudi Arabia has acquired a 70% interest in Wardieh Holdings, which has a network of about 180 service stations, a storage tank capacity of 250,000 barrels at Dora just northeast of Beirut, and a lubricants plant. Other partners in Wardieh Holdings are Mobil Middle East Export Corp. and Béryte Immobilière, each holding 15%; equity.

The bulk of cement manufacturing was centered in the northern coastal region of Chekka near abundant limestone and deep-draft port facilities. Cimenterie National SAL, financed by the International Finance Corp., increased capacity by 50% in 1997, to 1.5 million metric tons per year (Mt/yr). Other cement producers were the Société des Ciments Libanais, currently operating a 1.5-Mt/yr-capacity plant with contracts to expand to 2 Mt/yr; and Société Libanaise des Ciments Blancs. The demand for cement has grown from 1.4 Mt/yr in 1992 to more than 4 Mt/yr in 1997 as major public reconstruction projects got underway.

Power-generation capacity increased from 1,057 megawatts (MW) to 1,357 in September 1997 with the startup of a 150-MW turbine at the Zahrani and the Beddawi powerplants. Lebanon also imports electricity from Syria through the Tartous-Deir Nabouth powerline (Arab Petroleum Research Center, 1998). The government is considering converting power stations to natural gas. One proposal under study is the importation of liquified natural gas (LNG) from Qatar or the United Arab Emirates; this would require heavy investment in regasification and storage facilities, as well as pipeline networks. Lebanon hopes to obtain World Bank funding for the LNG project and invited bids for management, supervision, and consultancy contracts near the close of 1997. A second proposal under consideration is the import of natural gas from Syria and possibly Egypt. A joint Syria-Lebanon Gas Commission was established to investigate the possibility of the delivery of 3 million cubic meters per day of Syrian natural gas to Lebanon.

As part of the economic recovery plans, Lebanon sought to encourage investment by reducing the corporate income tax to 75% and establishing even more-favorable tax structures for offshore holding companies. Foreign investors are not rushing into Lebanon because the territorial conflict between Syria and Israel continues to be focused on the "security zone" in southern Lebanon.

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TABLE 1
LEBANON: ESTIMATED PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997
Cement, hydraulic	thousand metric tons	3,000 r/	3,450 r/	3,538 r/ 2/	3,500 r/	4,500
Gypsum		2,000	2,000	2,000	3,000	3,000
Iron and steel, metal, semimanufactures		80,000	80,000	80,000	80,000	80,000
Lime		25,000	28,000	30,000	30,000	40,000
Salt		3,000	3,000	3,000	3,500	3,500

r/ Revised.
1/ Table includes data available through October 15, 1998.
2/ Reported figure.

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THE MINERAL INDUSTRY OF

OMAN

By Bernadette Michalski

In 1997, the hydrocarbon mineral sector sustained Oman's developing economy, providing about 40% of the gross domestic product (GDP), 75% of all exports, and more than 77% of Government revenues. Oman's oil revenues alone were $3.91 billion in 1997. Other commercially viable mineral ventures included the mining of chromite; the smelting and refining of copper, with gold and silver as byproducts; the manufacturing of cement; and the production of crushed and dimension stone and sand and gravel. The mineral industry in total accounted for about one-half of the GDP.

The Petroleum and Mineral Law of Oman, effective since January 1, 1975, governed mineral activities in the country. All minerals are considered Government property until extracted. The royalty tax rate was fixed at 20% of the value of production by a 1976 decree. Although the Government maintained a majority interest in most companies, foreign partnerships were encouraged. The Oman Chromite Co. has limited Government participation with major equities held by private interests.

The Ministry for Oil and Gas superseded the Ministry for Petroleum and Minerals on December 17, 1997. Responsibility for nonhydrocarbon minerals was assigned to the Ministry of Commerce and Industry. In support of the Government's program to increase Omani nationals participation in industry, Shell Oman Marketing Company, distributor of petroleum products, floated 40% of its stock on the Muscat exchange. Private shareholders now hold 51%, and Shell holds 49% while retaining the casting vote.

Crude oil production achieved record levels as development activity and enhanced recovery operations continued. Less than 10% of the domestic output was refined in Oman. Surplus refined products, mostly fuel oil, were exported. Chromite production was entirely destined for export markets. The copper smelter and refinery operated by the Oman Mining Co. imported copper concentrates for toll and custom smelting. *(See table 1.)*

Oman exports the bulk of its crude oil production, about 810,000 bbl/d in 1997. The heavier crudes of the south and the lighter crudes of the north are gathered and blended into the Omani Export Blend (34° American Petroleum Institute (API) gravity). Most of Oman's petroleum exports were destined for Asia.

Shareholders in the Oman India Fertilizers complex in Sur—Oman Oil, Krishak Bharati, and Rashtriya Chemicals and Fertilizers—have contributed 25% of the proposed $1.1 billion fertilizers complex. International financing is sought for the remaining 75%. The complex will include two 1,750-metric-tons-per-day (t/d)-capacity ammonia units and two 2,200-t/d-capacity urea plants. Completion date is scheduled for 2001 (European Chemical News, 1998).

In August 1997, Japanese interests began mineral exploration in northern Oman under an agreement with the Omani Government committing the Japanese expenditure of $4 million on surveying and exploring for copper, gold and silver, and other minerals in a 2,900 square kilometer area on the Batina Coast between Rustaq and Sahm.

Construction began in early 1998 on a $3 billion, 480,000-metric-ton-per-year (t/yr)-capacity aluminum smelter to be constructed in four phases each of 120,000-t/yr capacity. The first 120,000-t/yr unit is scheduled to come on-stream in 2000; the three other units to follow between 2001 and 2002. The project will be funded by foreign and local investors, which includes 40% raised by public subscription through the Muscat exchange in 1998. Shareholders include Charus Enterprises of the United States, the Hong Kong branch of the China National Nonferrous Metals Industry Corporation, Simsen Metals of Hong Kong, and Oman's WJTowell & Co. The smelter is to be constructed in conjunction with a 1,800-megawatt-capacity natural-gas-fueled power station and a 30-million-gallon-per-day desalination plant.

The Oman Chromite Co. exploited the Ghashabi-2 deposit, producing 18,000 metric tons (t) of chromite in 1997. At least 4,000 t were exported to Japan, and unknown quantities were exported to the Refractories Corp. of the Philippines.

Copper cathodes, processed from imported concentrates were exported from the port of Majis, about 17 kilometers (km) northwest of Sohar.

Major developments in the natural gas industry highlighted Oman's mineral industry sector. A $2-billion financing package for the liquefied natural gas (LNG) plant of the Oman Liquefied Natural Gas LLC. The plant, to be located at Qalhat, 320 kilometers southeast of Muscat, will have dry gas inlet capacity of 34 million cubic meter per day and an LNG capacity of 6.6 million metric tons per year (Mt/yr). Two units of 120,000-cubic-meter storage capacity each are planned. Natural gas will be delivered from 60 to 70 wells in the Saih Rawl, the Saih Nihayda, and the Barik Fields. The gas is 82% to 86.5% methane, 6% to 7.7% ethane, 2.2% to 3.3% propane, and 1.2% to 1.85% butane. It contains 5 parts per million hydrogen sulfide, 1.2% carbon dioxide, 3.4% nitrogen, and 0.05% helium (Oil & Gas Journal, 1997). The Oman Liquefied Natural Gas LLC is a joint venture with the Government, reserving a majority equity position of 51%; Royal Dutch Shell, 34%; Total SA, 6%; Mitsubishi and Mitsui, each 3%; Partex, an Omani private company, 2%; and Itochu, 1%. Oman Liquefied Natural Gas LLC has signed Korea Gas Co is to receive 4.1 Mt/yr of LNG during a 25-year period and Osaka Gas of Japan for an offtake of 1.2 Mt/yr (Petroleum Economist, 1998a).

Petroleum Development Oman (PDO) led in hydrocarbon

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exploration in the nation with about 20 drilling rigs in operation through 1997 and in exploration expenses, which were budgeted at $220 million for the year (Oil & Gas Journal, 1998). In addition to PDO, 14 concession holders were also engaged in exploration, 3 of which entered into agreements with the Government in 1997—Nimir of Saudi Arabia, Gulfstream Resources of Canada, and Occidental Petroleum of the United States. In 1997, Triton Energy, also of the United States, reported completion of a 1,750 km two-dimensional seismic survey on offshore Block 22 in the Gulf of Masirah, a concession it was awarded in 1996. Shell and Amoco were negotiating for exploration rights during the year.

PDO accounted for about 97% of the nation's total petroleum production. The company is owned 34% by Shell, 60% by the Omani Government, 4% by Total SA, and 2% by Partex. Occidental Petroleum is the largest of the country's other equity producers and contributed about 40,000 bbl/d. Other producers in 1997 were Japan Petroleum Exploration Co. Ltd. (Japex) and Elf Aquitaine SA of France. Total petroleum production averaged 887,000 bbl/d. In 1997, Oman extracted about 2 million barrels per day of saline brines associated with its wells. Disposal is a major problem. At present, the water is being reinjected, but only in cases where local salination levels are higher than those in the water sourced from the wells. Total 1997 production costs have been estimated to be $3.74 per barrel (Petroleum Economist 1998b).

Oman's single refinery, Mina Al-Fahal, has a capacity of 80,000 bbl/d and is dedicated to meeting local demand. A second refinery is being considered for Salalah.

Proven copper ore reserves are 8 million metric tons (Mt), and proven chromite ore reserves are 2 Mt, which is made up of over 450 small chromite lenses. Recoverable petroleum reserves are 5.4 billion barrels. At least an additional 1.5 billion barrels could be recovered through secondary recovery methods. Recoverable reserves of natural gas have nearly tripled in the past 5 years to 780 billion cubic meters, most of which is nonassociated natural gas (Arab Petroleum Research Center, 1998).

The Sultanate of Oman had enjoyed a stable economy sustained by petroleum revenues for more than a decade. Improving technology augmented reserves that continued to outpace reservoir withdrawals. The development of the nation's natural gas reserves and increasing overseas investments will place Oman in a secure position when its own petroleum reserves are depleted, at current withdrawal levels, in about 2015. The LNG project will provide greater economic diversification, enhance trade relations, and provide more opportunities for employment for Omani nationals. Buyers for the majority of the plant's output are now guaranteed for at least 25 years. An offshoot of the LNG project will be the construction of a petrochemical complex, a new aluminum plant, a nitrogenous fertilizer plant, a new power station, a new container port, and a free-trade zone at Salalah. The budget deficit is scheduled to be eliminated by 2000 under the 1996-2000 Development Plan.

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TABLE 1
OMAN: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996 e/	1997 e/
Cement, hydraulic	thousand tons	1,000	1,200	1,177 r/	1,260 2/	1,300
Chromite, gross weight		1,236 r/	6,166	5,300 e/	15,252 2/	18,000 2/
Copper:						
Mine output, Cu content		8,800 r/	6,500	--	--	--
Metal:						
Smelter		27,700 3/	31,200 4/	34,200 4/	24,663 2/	22,800 2/
Refinery		20,539 5/	24,194 4/	33,900 4/	24,150 2/	23,600 2/
Gas, natural:						
Gross	million cubic meters	5,400	6,000 e/	6,860 r/ e	9,071 2/	6,700
Dry	do.	3,150	3,200 e/	3,015	3,176 2/	4,000
Gold	kilograms	90	137	591 r/	576 2/	577 2/
Gypsum		112,882	121,446	104,490	130,900	113,600 2/
Natural gas liquids e/	thousand 42-gallon barrels	2,300	2,300	3,000	3,650	3,800
Petroleum:						
Crude	do.	283,240	293,800	311,300	322,300	323,755 2/
Refinery products:						
Liquefied petroleum gas 6/				404	400	400
Gasoline	do.	4,500	4,600 e/	4,632 r/	4,888 2/	4,888
Jet fuel	do.	2,500	2,500 e/	2,000 e/	2,500	2,500
Kerosene	do.	90	90 2/	1,314 r/	90	90
Distillate fuel oil	do.	4,600	4,800 e/	5,523 r/	4,800	4,800
Residual fuel oil	do.	12,500	12,500 e/	13,606 r/	12,500	12,500
Other	do.	900	900 e/	500 r/	500	500
Total	do.	25,090	25,390 e/	27,575 r/	25,278	25,278
Sand and gravel	thousand tons	7,000 e/	8,000 e/	9,395 r/	9,629 2/	9,800
Silver	kilograms	3,300	1,500 e/	100 e/	97 2/	95
Stone:						
Marble	thousand tons	76	70	145 e/	117	169 2/
Other	do.	1,930	2,000 e/	2,119 e/	2,263	1,992 2/
Sulfur e/		40,000	40,000	35,000	30,000	30,000

e/ Estimated. r/ Revised.
1/ Table includes data available through November 1, 1998.
2/ Reported figure.
3/ Includes 17,800 metric tons of anode as toll/custom output.
4/ Includes toll/custom output.
5/ Includes 12,600 metric tons of cathode as toll/custom output.
6/ Included in Other category in 1993 and 1994.

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THE MINERAL INDUSTRY OF

QATAR

By Bernadette Michalski

Although crude oil continued to be Qatar's principal mineral commodity in 1997, it will be eclipsed by natural gas production from the North Field by 2000. The North Field is the largest known offshore nonassociated gasfield in the world with recoverable reserves of 7 trillion cubic meters in a 6,000-square-kilometer area in shallow waters off the Qatari northeast peninsula (Arab Petroleum Research Center, 1998). For the present, Qatar's economy remains largely dependent on the oil industry, which accounted for nearly 80% of total exports, 65% of Government revenues, and 37% of the gross domestic product in 1997.

Production of nonfuel minerals, such as cement and fertilizer materials, have grown; steel production, however, declined slightly. A 2,000-metric-ton-per-day (t/d)-capacity cement plant was inaugurated at Umm Bab in 1997. The existing 330,000-metric-ton (t)-capacity cement plant at the same location will be gradually phased out owing to obsolescence. *(See table 1.)*

The country's major trading partners are Brazil, the European Community, the Gulf Cooperation Council (GCC) nations, Japan, the Republic of Korea, and the United States. Qatar imported pelletized iron ore from Bahrain and raw materials for the steel and construction industries from the European Community, Japan, and the United States. Other imports from the United States included power-generating machinery and equipment; nonferrous metals, such as copper and copper alloys; aluminum semimanufactures; zinc and zinc alloys; vehicles; and heavy machinery. In 1997, total imports were valued at $5 billion and exports of all commodities totaled $5.8 billion (Arab Petroleum Research Center, 1998).

Construction of a 240,000-metric-ton-per-year-capacity aluminum smelter is under consideration as a joint venture between Qatar and Norsk Hydro ASA of Norway. The $1 billion smelter's completion is anticipated in 2002. The raw material, alumina, is to be supplied by India (Platt's Metals Week, 1998).

Almost all the output (90%) from Qatar Steel Co. Ltd. (QASCO) was exported, mostly to the GCC countries. QASCO remained 70% owned by the Government, with 30% held by two Japanese companies; Kobe Steel, Ltd. (20%), and Tokyo Boeki (10%). Qatar was negotiating with the Japanese firms for the purchase of their 30% equity. QASCO has embarked on a $275 million two-stage expansion program that would increase its capacity to 1.2 million metric tons per year (Mt/yr).

The Qatar Hot Briquetted Iron Company Ltd. was on schedule in the development of a 2- Mt/yr-capacity, $400 million hot-molded briquetted iron plant to be inaugurated by 2000. QASCO held 31% equity; Gulf Investment Company, Kuwait National Industrial Company, and Duferco International Investment Company Ltd. each held 16 1/3%; Qatar Industrial Manufacturing Company and Qatar Shipping Company, each held 10%. Ore supply contracts for the plant have reportedly been signed with Companhia Vale du Rio Doce of Brazil and Luossavarra-Kiirunavaara AB of Sweden. About 40% of the hot briquetted iron production is to be absorbed equally by QASCO and Kuwait National. Duferco will absorb the remaining 60%. (Qatar Hot Briquetted Iron Company Ltd., May 6, 1998, accessed on November 10, 1998, at URL http://www.midrex.com/main/recentnews/Quabicoprrelease.htm).

Qatar Fertilizer Company (QAFCO), the sole producer of fertilizer, was a 75%-25% joint venture of Qatar General Petroleum Corporation (QGPC) and Norsk Hydro, respectively. QAFCO III, a 1,500-metric ton per day (t/d)-ammonia and a 2,000-t/d urea plant was completed in 1997. Total annual capacity at the ammonia plants was raised from 750,000 metric ton (t) to 1.3 million tons (Mt) and at the urea plants, from 820,000 t to 1.55 Mt. Other components of the project included an ammonia tank farm with an annual capacity of 20,000 t, a 100,000-t urea storage facility, a desalination plant, and a 42-megawatt (MW) powerplant. A feasibility study is being conducted on a possible fourth fertilizer complex with 1,500 t/d of ammonia capacity and 2,000 t/d of urea capacity (Chemical Week, 1997).

The Government accelerated measures to attract foreign and local investors to participate in the economy, particularly in the natural gas industry. The Government, through QGPC, was involved in two major liquefied natural gas (LNG) ventures with foreign partners; both were at Ras Laffan, the nearest landfall to the offshore North Field. Qatar Liquefied Gas Co. (QATARGAS) is owned by QGPC (65%), Total SA of France and Mobil Oil of the United States (each 10%), and Marubeni Corp. and Mitsui & Co. of Japan (each 7.5%). The first 2-Mt/yr-capacity train was commissioned in 1996; the second, in early 1997; and the third is to be commissioned in 1999. QATARGAS secured a 25-year supply contract with a Japanese power company calling for the delivery of 4 Mt/yr of LNG. The Chubu Electric Power Co. received the first shipment (59,000 t) at the LNG reception terminal at Kawagoe, Japan, on January 10, 1997. The contract calls for the delivery of 2 Mt in 1997, 2.5 Mt in 1998, 3 Mt in 1999, and 4 Mt, the full contractual annual volume, in effect from 2000. A second contract was secured with a consortium of seven Japanese companies to offtake an additional 2 Mt/yr during a 25 year period beginning in 1999. In May 1997, QATARGAS concluded a short-term contract with Enagas of Spain for 320,000-t of LNG for delivery between 1997 and 1998.

A second LNG venture, the Ras Laffan LNG Co. (RASGAS) is owned by QGPC (66.5%), Mobil (26.5%), Itochu Corp. (4%), and Nissho Iwai Co. (3%). RASGAS is developing a 5-Mt/yr-capacity LNG plant at Ras Laffan, which is scheduled to come on-stream in mid-1999 and begin full operation by 2002. An agreement was

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concluded with Korea Gas in June 1997 to double the volume of LNG exports initiated in an earlier agreement from 2.4 to 4.8 Mt/yr during a 25 year period. The agreement calls for 600,000 t of LNG to be delivered in 1999, increasing to the contractual maximum of 4.8 Mt in 2002. Qatar was in various stages of negotiations with India, Lebanon, and Turkey as other possible outlets for RASGAS LNG. Should these negotiations materialize into firm contracts, RASGAS plans to double its capacity and export about 10 Mt/yr by 2005.

Crude oil production increased significantly in 1997, averaging 614,000 barrels per day (bbl/d) compared with 510,000 bbl/d in 1996. Increased output from Al-Shaheen and the newly commissioned Al Khaleej Field accounted for the rapid rise in production. Al-Shaheen, operated by Maersk Oil Qatar of Denmark, produced around 60,000 bbl/d in mid-1997, climbing to 100,000 bbl/d by the close of the year. Maersk plans to increase production to 150,000 bbl/d by 2000. Located in Block-5 about 70 kilometers (km) off Qatar's northeastern coast, Al-Shaheen produces a sour (29°-33° API) oil with 1.7%-2% sulfur. The field will also produce approximately 100 million cubic feet per day of associated gas.

Qatar has initiated a number of new policies to increase oil production, to locate additional oil reserves before existing reserves become too expensive to recover, and to invest in advanced oil recovery systems to extend the life of existing fields. To accomplish this, the Government has, in recent years, improved the terms of exploration and production contracts and production-sharing agreements. During the next several years, $27 billion will be invested to expand hydrocarbon production capacities in Qatar's upstream and downstream sectors. Of the $27 billion, more than half, or about $17.8 billion, will come from foreign companies. As a result, Qatar has become one of the world's most active drilling centers. At any given time, up to 15 rigs are working in Qatar's oil and gas-fields, and 177 new wells are being drilled for oil and gas development projects.

The National Oil Distribution Co., a subsidiary of QGPC, operates the nation's sole refinery. The 63,000-bbl/d-capacity Umm Said Refinery was undergoing upgrading, increasing distillation capacity to 80,000 bbl/d.

Proven reserves of crude oil are considered to be between 3.7 billion and 5 billion barrels. Natural gas reserves are estimated to be 8.5 trillion cubic meters (Arab Petroleum Research Center, 1998).

There were 235 km of petroleum and 400 km of natural gas pipelines running east to west from Doha to Dukhan and from Umm Said through Umm Bab to Dukhan. Other pipelines also linked offshore fields in the Arabian Gulf to Umm Said. Hydrocarbons were exported from five terminals--Halul Island, which served the offshore fields; Umm Said, which served the onshore fields; Ras Abu Abbud and Abu Hamur, which were terminals for refined products, and the Ras Laffan LNG terminal, which includes a 9-km quay and has the capacity to load 28 Mt/yr of LNG.

Qatar currently has an electric generation capacity of 1,400 MW, and produces 5.2 billion kilowatt-hours of electricity. The residential sector accounts for 80% of Qatar's electricity consumption. In March 1998, the Qatari Government took a small step towards privatizing of its power sector. The Ministry of Electricity and Water, which controls virtually all the country's powerplants, agreed to transfer operation and maintenance responsibilities to the Ras Abu Fontas-B plant to the Qatar Electricty & Water Company (QEWC). QEWC controled by local investors (57%) and the Government (43%). The Ras Abu Fontas B-plant is the country's largest and newest power and water desalination plant. It has an electric generation capacity of 650 MW and water output of 33 million gallons per day. The operation and maintenance responsibilities are scheduled to be transfered to QEWC in July 1998.

The North Field natural gas projects continue to be given top priority, and if they attain their full development by 2010, as planned, they should underwrite Qatar's economic well being through the next century. Other mineral industry projects may be in a more-tenuous position in the near term as Government oil revenues decline owing to persistently low world oil prices. The petroleum refining and petrochemical, the aluminum and iron and steel, the electric power, and the desalination projects now under development may be delayed until revenues from the LNG program can be realized or world oil prices improve.

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TABLE 1
QATAR: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997
Cement, hydraulic		544,000	469,502	475,380	690,000 r/ e/	700,000 e/
Gas, natural:						
Gross	million cubic meters	18,400	18,300	18,800	18,950 r/	27,000
Dry	do.	13,500	13,500	13,600	13,700 r/	21,500
Iron and steel, metal:						
Direct-reduced iron	thousand tons	601	610	622	632	570
Steel, crude	do.	620	572	614	626	616
Semimanufactures:						
Billet	do.	609	610	606	617	608
Bars	do.	590	600	601	601	596
Natural gas liquids e/	thousand 42-gallon barrels	18,200 3/	18,200	18,500	21,000	22,000 3/
Nitrogen:						
N content of ammonia		627,200	646,055	653,462	635,027	942,500
N content of urea		379,600	394,600	407,500	400,300	490,400
Petroleum:						
Crude	thousand 42-gallon barrels	142,000	138,200	142,300	186,150 r/	224,110
Refinery products:						
Gasoline	do.	3,350	4,661	4,441	3,942 r/	4,000 e/
Kerosene	do.	2,845	3,377	3,217	3,321 r/	3,350 e/
Distillate fuel oil	do.	4,890	5,480	5,126	6,997 r/	7,000 e/
Residual fuel oil	do.	5,730	6,278	6,064	6,860 r/	6,900 e/
Other	do.	1,240	1,000	900	1,100 r/	1,100 e/
Total	do.	18,055	20,796	19,748	22,220 r/	22,350 e/
Stone, limestone e/	thousand tons	900	900	900	900	900
Sulfur e/		72,000 r/	62,000 r/	50,000 r/	45,000 r/	65,000
Urea		825,000	858,000	886,000 e/	870,000	875,000 e/

e/ Estimated. r/ Revised.

1/ Table includes data available through November 1, 1998.

2/ In addition to commodities listed, clays, gypsum, and sand and gravel for construction purposes are produced, but available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

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THE MINERAL INDUSTRY OF

SAUDI ARABIA

By Bernadette Michalski

In 1997, the Kingdom of Saudi Arabia, the world's largest producer of crude oil, accounted for 13% of the total world output. In recent years, the Kingdom has achieved a significant diversity in its mineral industry through the development of gold mining operations and value-added cement, fertilizer, petrochemical, and steel manufacturing facilities. Awaiting exploitation are the Az Zabirah bauxite, the Wadi Sawawin iron ore, the Al Jalamid phosphate, the Jabal Sayid copper, and the Khnaiguiyah zinc-copper deposits, which are expected to add to this diversity and, consequently, to reduce reliance on petroleum earnings. The bulk of revenues and export earnings, however, continue to be generated by the hydrocarbon industries, including downstream refining and petrochemicals. Petroleum accounted for 70%, or $41.5 billion[1], of Government revenues and 38% of the gross domestic product (GDP) in 1997 compared with 35% in 1994. The nonoil industries accounted for 8% of the GDP (Arab Petroleum Research Center, 1998, p. 403).

Government Policies and Programs

The Deputy Ministry for Mineral Resources (DMMR) has enlisted the cooperation of the U.S. Geological Survey (USGS) and the Bureau de Recherches Géologiques et Minières of France in the mineral exploration and assessment of the mineral resources of the country. The results of more than 30 years of exploration have been made available in open-file reports, technical reports, bulletins, annual reports, and geoscience maps available through the USGS.

The Government has focused on development of the Kingdom's resources of bauxite, copper, gold, iron ore, phosphate rock and zinc. The Government encouraged private interests to participate in the Kingdom's economic development by offering low-interest or interest-free loans to qualified companies.

The state-owned Saudi Arabian Mining Co. (Ma'aden), capitalized at more than $1 billion, was created in April 1997. The company is to spearhead exploration and mining activities in Saudi Arabia on a commercial and profitable basis. It is also mandated to promote the development of downstream production facilities. The privatization of Ma'aden within 6 years is under consideration. The company is to study and propose possible changes in mining legislation that would encourage further private investment. One of the basic challenges is to provide infrastructure in the remote areas where most mineral deposits are located. One consideration is the development of a national railroad network connecting Dammam with Al Jubayl and Jiddah with Dammam. An integrated mining and transportation policy is expected in the near future.

[1]Where necessary, values have been converted from Saudi riyals (Srls) to U.S. dollars at the rate of Srls3.7450=US$1.00.

Environmental Issues

Saudi Arabia created a ministerial committee to set standards, such as emission controls, and procedures, such as monitoring air and water pollution, for environmental protection. The committee drew its membership from the 12 ministries. Each ministry carried out its own environmental audit under the guidance of the Central Department on the Environment and the Department of Meteorological Observation and Environment.

Production

In 1997, the average production of crude oil, including the Saudi Arabian share of production from the Partitioned Zone shared with Kuwait, was 8.56 million barrels per day (Mbbl/d). Although actual production capacity is 10 Mbbl/d, output has been averaging more than 8 Mbbl/d in recent years in accordance with the quota assigned by the Organization of Petroleum Exporting Countries (OPEC). Saudi Arabia also produces cement and other industrial and construction materials including ornamental stone. In the metals group, copper, gold and by-product silver, and zinc are produced. Steel is produced from scrap and imported iron ore pellets. *(See table 1.)*

Trade

Of the total exports in 1997, valued at $54.3 billion, crude oil and petroleum products accounted for 87%, valued at $47.3 billion. Crude oil exports averaged 6.3 Mbbl/d, and petroleum product exports averaged 850,000 barrels per day (bbl/d). During 1997, Europe imported more than 1.9 Mbbl/d of crude oil and petroleum products, and Japan imported more than 1.4 Mbbl/d. Imports of Saudi Arabian crude oil and products by the United States totaled nearly 1.4 Mbbl/d including 111,000 bbl/d of petroleum products, mostly unfinished oils and motor gasoline. Saudi Arabia remained the leading supplier to the United States, accounting for 14% of U.S. petroleum imports in 1997 (Energy Information Administration, 1998, p. 82).

The value of nonoil exports increased rapidly during the past decade. In 1997, they were valued at $7 billion compared with about $1 billion in 1983. This trend was expected to continue as more industries come on-stream and existing facilities are expanded.

The Kingdom's total imports were valued at about $25 billion in 1997. The United States remained the largest supplier to the Kingdom and accounted for nearly one quarter of Saudi Arabia's imports.

Most imports were subject to customs duties at rates ranging from 12% to 20%. Imports from members of the Gulf Cooperation Council (GCC) were exempted, provided that at least 40% of the value added was effected in GCC countries and at least 51% of the

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capital of the producing firm was owned by citizens of GCC-member countries.

Monetary authorities and all other residents, including private persons, could freely and without license purchase, hold, and sell gold in any form, at home or abroad. They could without license and without payment of any customs duty or tax trade gold in any form, with the exception of gold of 14 carats or less, the import of which was prohibited.

Structure of the Mineral Industry

All minerals, including vast petroleum and natural gas reserves, were owned by the Government. Exploitation was predominantly controlled by Government organizations. *(See table 2.)* The Government-owned Saudi Aramco was the only company authorized to engage in oil and gas exploration and development within Saudi Arabia. Many industrial projects, however, were joint ventures between Saudi firms and foreign partners. At the close of 1997, there were 1,352 such joint ventures. Most of these were involved in petrochemical, petroleum refining, electrical engineering, and electronics activities; the capital investment totaled nearly $35 billion, about 60% of which was Saudi capital (Arab Petroleum Research Center, 1998, p. 397).

Commodity Review

Metals

Aluminum.—A 1-million-metric-ton-per-year (Mt/yr) alumina plant has been approved for construction at the Al Jubayl Industrial Estate by the Government of Saudi Arabia. The $1 billion project is scheduled to be completed within 5 years. Imported and domestic bauxite probably will be used as feedstock; the alumina probably will be exported to the United Arab Emirates for the Dubai Aluminium Co. (Metal Bulletin, 1997).

Bauxite.—The DMMR continued plans for exploitation of the Az Zabirah bauxite deposit about 470 kilometers (km) northwest of Riyadh and 615 km from the proposed alumina plant site. The deposit was part of a Cretaceous paleolaterite that outcropped in three main zones covering a distance of 105 km. The DMMR reported that minable reserves were 102 million metric tons (Mt) of essentially aluminum monohydrate ores averaging 57.5% aluminum oxide, 8% ferric oxide, and 5.5% silicon dioxide.

Copper.—The Alujain Corp. of Saudi Arabia has placed a hold on its plans to develop a large copper deposit at Jabal Sayid in the Arabian Shield about 340 km northeast of Jiddah. The deposit was defined at 80 Mt grading 1.5% copper. The proposed 150,000 metric-ton-per-year (t/yr) copper smelter at Madinat Yanbu Al Sinalyah on the Red Sea coast was also put on hold.

Ferroalloys.—The Gulf Ferroalloys Co., owned by GCC investors, brought a ferroalloy complex on-stream in mid-1996 at Al Jubayl, a location accessible to high-purity quartz and inexpensive energy. The complex had a capacity of 105,000 t/yr of ferrosilicon, ferromanganese, silicomanganese, and silicon. The ferrosilicon production was expected to be exported because domestic needs did not exceed 3,000 t/yr. Ferromanganese, silicomanganese, and silicon metal production was intended for local consumption, principally the steel and aluminum industries in the region.

Gold.—Gold recovery continued at the high-grade Mahd Adh Dhahab underground mine, 270 km northeast of Jiddah, and at the Sukhaybirat open-pit mine, about 480 km northwest of Riyadh. A third deposit, Al-Amar, 220 km southwest of Riyadh, was being developed for underground mining.

In 1997, Mahd Adh Dhabab processed nearly 200,000 metric tons (t) of ore averaging 24.41 grams per ton (g/t) gold and 131.24 g/t silver. Gold production, including more than 0.5 t recovered from heap leaching, was nearly 4.32 t as bullion and more than 1.0 t in concentrate for a total of 5.32 t compared with 4.88 t in 1996.

The Saudi Company for Precious Metals, Ltd. (SCPM) operated the Sukhaybirat East Mine producing more than 1.47 t gold by carbon in leach from 650,000 t of ore grading 2.5 g/t gold and more than 0.46 t gold by heap leaching 606,000 t at 0.89 g/t gold for a total of 1.94 t gold compared with 2.65 t in 1996. Reduced output from Sukhaybirat was attributed to difficulties at the crusher plant which restricted mill throughput. The lower throughput was partly offset by higher gold grades. Gold output of the Kingdom was expected to double by 2000 (Northern Miner, 1997).

The Dhahab Co. Ltd., a Saudi Arabian-French joint venture, operated a 110-t/yr-capacity gold refinery at Jiddah using scrap gold jewelry and domestic and imported bullion.

Iron and Steel.—The Saudi Iron and Steel Co. (Hadeed) was undergoing the third stage of its expansion program, which includes the installation of an 850,000 t/yr capacity flat steel rolling mill. The plant is scheduled for completion in 1999 and will increase Hadeed's total production capacity of a variety of semimanufactured steel products to 3.55 Mt/yr. Feedstock for the plant will be obtained from a fourth direct reduction unit now under construction and is scheduled to come on-stream in 1999.

Silver.—Mahd Adh Dhabab Mine produces silver as a byproduct of gold recovery. In 1997, nearly 200,000 t ore averaging 131.24 g/t silver was processed yielding 3.65 t silver in bullion and 13.25 t in concentrate. About 0.31 t silver was recovered by heap leaching old mine tailings at Mahd Adh Dhabab.

Zinc.—The Arabian Shield Development Co. of Dallas, Texas, in partnership with the Al Mashreq Company for Mining Investments have formed a joint venture, Arabian Shield Company for Mining Industries (Arabian) to mine and process Al Masane polymetallic ores. The Al Masane deposit, in southwestern Saudi Arabia, contains demonstrated reserves of 7.2 Mt averaging 5.33% zinc, 1.44% copper, 1.2 g/t gold, and 43 g/t silver. Output was anticipated to be 58,000 t/yr of zinc concentrates containing 54% zinc, 34,900 t/yr of copper concentrates containing 25% copper, and 22,000 ounces of gold and 800,000 ounces of silver from the copper concentrate and the doré bullion, which is to be produced from the cyanidation plant to be built at the mine site. Financing for the $89-million project was formalized by the December 1997 approval of a $38-million interest-free loan from the Saudi Industrial Development Fund. Arabian will provide $26 million, and the remaining $25 million is to be obtained from commercial banks in Saudi Arabia and the Gulf area (Middle East Economic Digest, 1998a). Mine products will be delivered to custom smelter

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and refineries outside Saudi Arabia (Metal Bulletin, 1998).

Industrial Minerals

Cement.—The Southern Province Cement Co. commissioned a second plant in mid-1997. Located southwest, about 65 km south of Bishah, the plant's cement capacity will be 1.3 Mt/yr and will include a 40-megawatt (MW) power station.

Cement producers reduced output by 6%, to 15.4 Mt as capacity surpassed demand in 1997. Local deliveries were 14 Mt. Of the remainder, 1.3 Mt was exported principally by Saudi Cement Company (Middle East Economic Digest, 1998b).

Fertilizers.—The Kingdom's fertilizer producers were in a position to become dominant suppliers of nitrogen fertilizers in the international market. In 1997, the Saudi Arabian Fertilizer Co. (SAFCO) entered into a construction contract for a second plant at Al Jubayl. The plant, to be operational in 2000, will raise Safco's urea production capacity to 1.5 Mt/yr and ammonia capacity to 1.2 Mt/yr. The National Chemical Fertilizer Co. (Ibn Al Baytar) was constructing facilities for the production of 887,000 t/yr of sulfuric acid, 265,000 t/yr of phosphoric acid, and 16,400 t/yr of aluminum fluoride. The new units are scheduled to enter production in 2000. Phosphoric acid requirements were imported from Morocco. In May 1997, the Al Jubayl Fertilizer Co. (SAMAD) announced the construction of a phthalic anhydride plant to come on-stream in the last quarter of 1999 (Arab Petroleum Research Center, 1998, p. 389).

Phosphate.—The phosphate rock deposit in Al Jalamid, about 120 km from Turayf, near the Jordanian border, has proven reserves of 213 Mt of ore averaging 21% diphosphorus pentoxide. The deposit is to be developed by Ma'aden and a consortium of private companies. The beneficiation process was expected to produce 4.5 Mt/yr of phosphate concentrate that will be transported 1,200 km to Al Jubayl where it will be the feedstock for 2.9-Mt/yr diammonium phosphate plant (Fertilizer Week, 1997).

Mineral Fuels

Natural Gas.—Most of Saudi Arabia's known natural gas reserves occur as associated gas; Saudi Aramco has, however, focused exploration on the periphery of the giant Ghawar Field in the hope of discovering gas-bearing structures beneath the oil reservoir. In 1997, accumulations of nonassociated gas were discovered at Al Tayinat, 45 km southeast of Ghawar, and at Al Wafra, 30 km southwest of Ghawar. These discoveries added 2 billion cubic meters to the Kingdom's nonassociated natural gas reserves now totaling nearly 2 trillion cubic meters (Arab Petroleum Research Center, 1998, p. 373).

The Kingdom's Master Gas System (MGS) had the capacity to transport 164 million cubic meters per day (Mm^3/d) of natural gas; the processing plants at Berri, Shedgum, and Uthmaniya, however, had a processing capacity of only 113 Mm^3/d. Saudi Aramco launched an expansion program to increase the combined capacity of the three existing plants to 148 Mm^3/d while constructing a 40-Mm^3/d gas processing plant at Hawiyah. The MGS transmission system is to be expanded to 188 Mm^3/d. The Ju'aymah natural gas liquids (NGL) plant was also being expanded through the installation of a third fractionation train that will raise capacity by 300,000 bbl/d to 600,000 bbl/d bringing total NGL plant capacity to 900,000 bbl/d including the 300,000 bbl/d-capacity Yanbu NGL plant (Arab Petroleum Research Center, 1998, p. 375).

Saudi Arabia was the largest producer and exporter of methanol in the Arabian Gulf. In 1997, the Ar Razi plant production capacity of 1.28 Mt/yr was expanded with the addition of a third methanol plant; this raises Ar Razi capacity to 2.13 Mt/yr. Saudi Arabia's second methanol plant, the Ibn Sina plant, had a production capacity of 900 t/yr. In addition to marketing methanol from these two domestic facilities, Saudi Basic Industries Corp. (SABIC) also marketed methanol from Bahrain.

Petrochemicals.—SABIC ranked as the world's third largest producer of petrochemicals, accounting for 23.7 Mt of chemicals, petrochemicals, and plastics. The principal markets for these products were the Far East and Western Europe. New facilities were scheduled to come on-stream in 1998 at Ibn Rushd and additional capacity was slated to come on-stream in 1999 at Ar Razi, Ibn Al Baytar, and Kemya, which should result in an upsurge of petrochemical exports at the close of the decade (Arab Petroleum Research Center, 1998, p. 385).

SABIC planed to expand petrochemical production at Saudi Yanbu Petrochemical Co. Upstream expansion will be limited by the availability of feedstock from Saudi Aramco, which transports raw materials through a 1,000-km pipeline from the Arabian Gulf to Yanbu on the Red Sea coast. In 1997, Saudi Arabia was the world's largest producer of the fuel additive, methyl tertiary butyl ether (MTBE); affiliates of SABIC had a total production capacity of 2.8 Mt/yr of the gasoline additive.

The Alujain Corp. had a 850,000-t/yr-capacity MTBE plant under construction in Yanbu. The technical services and project management consultant was Bechtel of the United States. The plant completion is scheduled for early 2000. Planned feedstock totals are 12,000 bbl/d of butane from the Yanbu fractionation center and 9,000 bbl/d to be transported by tanker from the East Coast of the Arabian Peninsula.

Petroleum.—Production.—In 1997, Saudi Arabia maintained an average production level of 8.56 Mbbl/d, including output from the Partitioned Zone where production is shared with Kuwait. Nearly two-thirds of the output consisted of the higher priced crudes—more than 4 Mbbl/d of Arabian Light (34° API gravity), about 950,000 bbl/d of Arabian Extra Light (38° API gravity), and 200,000 bbl/d of Arabian Super Light (50.4° API gravity)—to maximize revenues while operating within the production quota allotted by OPEC. Saudi Arabia's quota for the period between 1993 and 1997 was 8 Mbbl/d, not inclusive of the crude oil from the Partitioned Zone. The new OPEC quota allotted for 1998 was 8.76 Mbbl/d. Because oil prices remained low in 1998, Saudi Arabia negotiated a production restraint agreement in March 1998 with other petroleum-exporting nations that resulted in a 300,000-bbl/d cut in Saudi production.

Located in the center of the Kingdom, in the Najd region, four new fields came on-stream in 1994—Ghinah, Hawtah, Hzmiyah, and Umm Jurf. The fields are linked to the central production station at Hawtah which included a 200,000-bbl/d gas oil separator plant. Development of the fifth field in the region, the Nuayyim Field, was reactivated in September 1997 after being postponed in 1995.

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The Ash Shaybah Field in the remote southeast with reserves of 14 billion barrels of 41.6° API gravity crude oil came on-stream in 1998 at 200,000 bbl/d rising to 500,000 bbl/d by early 1999. At that time, the export crude known as Arab Light (38° API) is expected to be replaced by the Shaybah blend with API gravity of 38.4°. The blend will consist of 40.74% Abqaiq, 37.04% Shaybah, and 22.22% Berri crude.

By 2000, Saudi Arabian Texaco anticipates that a $500-million development program will result in the doubling of production to 400,000 bbl/d from its onshore fields in the Partitioned Zone. At that time, the company will also begin recovering and marketing associated natural gas, which here-to-fore, was flared. In the same time period, the Arabian Oil Co. has a development program for increasing the combined production capacity of the Khafji and the Hout Fields to 350,000 bbl/d.

Refining.—The combined capacity of eight refineries, including the 30,000-bbl/d Al Khafji refinery in the Partitioned Zone, was about 1.7 Mbbl/d. *(See table 2.)*

Saudi Aramco's Ras Tanura refinery was undergoing a $1.5-billion upgrading and expansion, including the installation of a 100,000-bbl/d hydrocracker, a 40,000-bbl/d continuous catalytic reformer, a 60,000-bbl/d visbreaker, a sulfur recovery unit, a hydrogen plant, and a sour-water-treatment plant. The units were scheduled to come online in mid-1998 raising Ras Tanura's capacity from 265,000 bbl/d to 300,000 bbl/d. Foster Wheeler of the United States was awarded a project management contract for the $1.8-billion upgrading of the Rabigh refinery. The upgrading was designed to improve efficiency, as well as to increase output of light products—gasoline, jet fuel, and kerosene. This upgrading would enable Saudi Aramco to satisfy growing domestic demand for gasoline which is projected to reach 260,000 bbl/d by 2000. The demand for gasoline in recent years has ranged from 200,000 to 220,000 bbl/d. (Alexander's Gas & Oil connections, July 23, 1997, Saudi Arabia is upgrading its refineries, News and Trends—Middle East, v. 3, issue 3, accessed on April 21, 1998, at http://www.gasandoil.com/ goc/news/ntm73003.html). Saudi Aramco also was engaged in major revamping of its domestic distribution network that involved laying product pipelines from the refineries to the Kingdom's major consumption and export areas. In addition to its indigenous refineries, Saudi Arabia acquired a worldwide network of refining, storage, and distribution facilities. These include 50% equity in the Motor Oil Theodori Hellas' Corinth refinery in Greece, the Thalin Refinery in China, the Sangyong Oil Refining Co. in the Republic of Korea, the Aghii refinery in the Philippines, and the Star Enterprise in the United States. Saudi Aramco had a direct interest in downstream refining and market ventures that can process up to 1.4 Mbbl/d of the Kingdom's crude oil.

Reserves

Saudi Arabia has the world's largest known concentration of oil, representing more than 26% of total proven world reserves. Proven oil reserves are 263.5 billion barrels, including 2.5 billion barrels contained in the Saudi Arabian share of reserves in the Partitioned Zone. Saudi Arabia is enjoying a reserve-to-production ratio sufficient to last about 90 years at current production levels. The bulk of the Kingdom's reserves were contained in a few massive fields in the northeast. These included Ghawar, the world's largest onshore field, with remaining reserves of about 70 billion barrels; Safaniya, the world's largest offshore field with 19 billion barrels; Abqaiq, 17 billion barrels; Berri, 11 billion barrels; Manifa, 11 billion barrels; Zuluf, 8 billion barrels; Ash Shayba, 7 billion barrels; Abu Saafa, 6 billion barrels; and Khursaniya, 3.5 billion barrels.

Natural gas reserves were reported by Saudi Aramco to be 5.88 trillion cubic meters including 99 billion cubic meters in the Partitioned Zone. Most of the Kingdom's reserves were in the form of associated gas contained in the country's oilfields. The giant Ghawar Field accounted for approximately 35% of the total gas reserves. Non associated natural gas accounted for nearly 2 trillion cubic meters including two 1997 discoveries (Arab Petroleum Research Center, 1998, p. 355).

Infrastructure

Electric power generation and distribution are conducted under the regional authorities of the Saudi Consolidated Electric Companies operating powerplants with a combined installed capacity of more than 20,000 MW. Additional power-generation capacity (2,750 MW) is under the authority of the Saline Water Conversion Corp., which operates seawater-desalination plants. Electric power installed capacity is scheduled to increase to about 28,000 MW in 2000 and to 60,000 MW in 2020. In 1997, 56% of the generating capacity is provided by gas-fired power stations.

Saudi Arabia is the world's largest producer of desalinated water. In 1997, installed capacity exceeded 2 Mm^3/d. Expansion plans parallel industrial requirements.

Extensive port and harbor facilities served Al Jubayl on the east coast with access to the Arabian Gulf and Yanbu on the west coast with access to the Red Sea. Al Jubayl had an industrial port with a 10-km-long causeway for dry and liquid bulk cargo and a commercial port for general cargo. The fertilizer terminal consists of two jetties for loading 5,000- to 50,000 deadweight ton (dwt) vessels. The oil terminal at Yanbu was expanded to handle 6.6 Mbbl/d and could accommodate tankers from 80,000 to 500,000 dwt (Middle East Economic Digest, 1997).

Outlook

Saudi Aramco intends to maintain a maximum sustainable crude oil capacity of approximately 10 Mbbl/d. To implement this plan, less-profitable fields will be shut down as new producing fields come on-stream. Revenue increases can be anticipated through cutting back on the sale of Arabian heavy in favor of the lighter premium crudes from recently developed fields south of Riyadh. The United States and Saudi Arabia share a common concern about regional security, oil exports and imports, and sustainable development. The continued availability of reliable sources of oil, particularly from Saudi Arabia, remains important to the prosperity of the United States, as well as to Europe and Japan. Saudi Arabia maintains 2 Mbbl/d of surplus capacity to respond to crises.

Because most of the national income is dependent upon markets outside the Kingdom, the economy remains vulnerable to sudden changes in volume and pattern of worldwide trade in crude and refined petroleum and petrochemicals. Direct investment in foreign refining, marketing, and distribution operations should provide stability in the face of inevitable market fluctuations. Equities purchased in foreign refining, marketing, and distribution companies reduced the Kingdom's vulnerability. Saudi Aramco,

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however, recently canceled a proposed refining project in Portugal because downstream opportunities in Asia, particularly in India, were more promising. The Kingdom plans to build a long-term downstream presence in the region.

Saudi Arabia adopted an integrated view of the best use of natural resources and will develop natural gas reserves to satisfy the escalating demand for electricity in the Kingdom and to increase the availability of more oil for export. During the next 25 years, investments as much as $140 billion will be required to meet domestic power requirements (Wall Street Journal, 1997). The economy has progressed rapidly, and the standard of living has improved significantly. Dependence on petroleum revenues will continue, but industry and agriculture now account for a larger share of economic activity. The creation of Ma'aden should allow the mining sector to contribute more efficiently to the Kingdom's economic development. The economy is expected to witness sustained growth during the next 10 years as the proposed mining projects are implemented.

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TABLE 1
SAUDI ARABIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Ore, mine output:						
Gross weight 2/		859,353	900,000 e/	1,400,000 e/	1,569,205	1,600,000
Copper content of concentrate and bullion 3/		925	917	925 e/	834 e/	703 4/
Gold content of concentrate and bullion 2/ 3/	kilograms	7,519	7,630 e/	8,080	7,530 r/	7,260 4/
Lead content of concentrate e/ 3/		50	50	50	50	50
Silver content of concentrate and bullion 2/ 3/	kilograms	17,990	16,990	16,900 e/	16,608	17,200 4/
Zinc content of concentrate e/ 3/		542 4/	500	500	500	619 4/
Iron and steel:						
Direct-reduced iron	thousand tons	2,015	2,111	2,129	2,300 r/	2,110 4/
Iron and steel; metal, steel, crude	do.	2,318	2,411 e/	2,451	2,683 r/	2,539 4/
Ferroalloys	do.	--	--	--	20,000 e/	83,000
INDUSTRIAL MINERALS						
Barite		2,000 r/	5,000 r/	6,000 r/	8,000 e/	5,500 4/
Caustic soda		NA	NA	NA	450,000	450,000
Cement, hydraulic	thousand tons	15,300	16,000	15,773	16,437	15,400 4/
Gypsum, crude		326,661	375,000	370,000	362,589	365,000
Lime e/		150,000	160,000	175,000	180,000	160,000
Nitrogen:						
N content of ammonia	thousand tons	1,097	1,340	1,327	1,386 r/	1,405 4/
N content of urea	do.	780	994	980	1,010	930 4/
Pozzolan		NA	NA	NA	144,000 e/	145,000
Salt		60,000	60,000	90,000	140,000	140,000 4/
Stone, dimension e/		500,000	500,000	500,000	450,000	450,000
Sulfur; byproduct, hydrocarbons e/	thousand tons	2,400	2,300	2,400	2,300	2,400
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural: 5/						
Gross	million cubic meters	67,300	68,000 e/	73,900	77,700 r/	80,300 4/
Dry	do.	35,900	37,700 e/	38,030	41,340	43,900 4/
Natural gas liquids: e/						
Propane	thousand 42-gallon barrels	120,450 4/	120,500	147,500	147,000	150,000
Butane	do.	56,575 4/	56,600	60,000	60,000	65,000
Natural gasoline and other	do.	40,150 4/	45,000	48,000	47,400	48,900
Total	do.	217,175 4/	222,100	255,500	254,400	263,900 4/
Petroleum:						
Crude	do.	2,990,000	2,970,000	3,004,300	2,999,550	3,080,235 4/
Refinery products:						
Liquefied petroleum gases	do.	14,965	13,000 e/	11,315	12,000 e/	12,000
Gasoline	do.	89,425	92,800	85,000	94,462 r/	95,000
Jet fuel	do.	25,200	30,000 e/	21,900	23,000 r/	23,000
Kerosene	do.	35,770	36,450 e/	36,865	40,875 r/	41,000
Distillate fuel oil	do.	171,800	169,800	172,280	191,990 r/	192,000
Residual fuel oil	do.	180,700	156,640	167,200	180,565 r/	181,000
Unspecified	do.	62,580	73,900 e/	73,400	68,000 r/	68,000
Total	do.	580,440	572,590 e/	567,960	610,892 r/	612,000

e/ Estimated. r/ Revised. NA Not available.

1/ Table includes data available through December 31, 1998.

2/ Production from Mahd Adh Dhahab and Sukhaybirat gold operations.

3/ Mahd Adh Dhahab produces a bulk flotation concentrate containing copper, gold, lead, silver, and zinc and a crude bullion containing copper, gold, and silver.

4/ Reported figure.

5/ Includes Saudi Arabian one-half share of production in the Saudi Arabia-Kuwait divided zone.

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TABLE 2
SAUDI ARABIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Barite metric tons	The International Trading and Technical Establishment	Jiddah	6,000
Cement	Saudi Consolidated Cement Co. (Government, majority shareholder)	Ayn Dar, 75 kilometers southwest of Dammam	1,875
Do.	do.	Al Hufuf	1,800
Do.	Arabian Cement Co. Ltd. (Government, 100%)	Rabigh	2,000
Do.	Southern Province Cement Co. (Government, 100%)	Suq Al Ahad, 10 kilometers northeast of Jizan	2,500
Do.	do.	Bishah, 550 kilometers southeast of Jiddah	1,300
Do.	Yanbu Cement Co. (Government, 100%)	Yanbu	1,500
Do.	Yamama Cement Co. (Government, 100%)	Riyadh	3,000
Do.	Qasim Cement Co. (Government, 100%)	Buraydah	1,400
Ferroalloys	Gulf Ferroalloys Co. (SABAYEK) (United Gulf Industries Corp., 26%; SABIC, 15%; Demetal Aussenhandelsgesellschaft, 7%; remainder owned by Arab investors and financial institutions)	Al Jubayl	105
Fertilizer:			
Urea	Al Jubayl Fertilizer Co. (SAMAD) (SABIC, 50%; Taiwan Fertilizer Corp., 50%)	do.	632
Ammonia	do.	do.	300
Dioctyl phthalate	do.	do.	50
2-EH	do.	do.	150
Urea	National Chemical Fertilizer Co. (Ibn Al Baytar) (SABIC, 50%; SAFCO, 50 %)	do.	500
Granular urea	do.	do.	500
Ammonia, liquid	do.	do.	500
NPK	do.	do.	500
TSP	do.	do.	200
DAP	do.	do.	100
Liquid fertilizer	do.	do.	10
Urea	Saudi Arabian Fertilizer Co. (SAFCO), (SABIC, 41%; Saudi Arabian private interests, 59%)	Dammam	330
Ammonia	do.	do.	200
Sulfuric acid	do.	do.	100
Melamine	do.	do.	20
Ammonia	do.	Al Jubayl	500
Granular urea	do.	do.	600
Gold:			
Ore	Mahd Adh Dhahab Mining Company (Ma'aden) (Government, 100%)	Mahd Adh Dhahab, 270 kilometers northeast of Jiddah	180
Metal kilograms	do.	do.	5,000
Ore	The Saudi Company for Precious Metals (SCPM) (Ma'aden, 50%; Boliden International Mining, 50%)	Sukhaybirat, 480 kilometers northwest of Riyadh	1,300
Metal kilograms	do.	do.	2,800
Refinery metric tons	Dhahab Company Ltd. (Saudi private interests, 51%; Thomson-C.S.F., 49%)	Jiddah	110
Natural gas million cubic meters	Saudi Aramco (Government, 100%)	All oilfields, Eastern Province	60,000
Do. do.	do.	Khuff Zone, Eastern Province	20,150
Do. do.	do.	Abqaiq Gas Cap, Eastern Province	4,600
Natural gas liquids 1/ million barrels	do.	Shedgum, 150 kilometers southwest of Dammam	60
Do. do.	do.	Uthmaniya, 30 kilometers west of Al Hufuf	120
Do. do.	do.	Berri, 15 kilometers north of Al Jubayl	25
Do. do.	do.	Ju'aymah, 33 kilometers northwest of Ras Tanura	110
Do. do.	do.	Yanbu	110
Petrochemicals:			
Ethylene	Saudi Petrochemical Co. (SADAF) (SABIC, 50%; Pecten Saudi Arabia, 50%)	Al Jubayl	970
Ethylene dichloride	do.	do.	560
Styrene	do.	do.	360

See footnotes at end of table.

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TABLE 2--Continued
SAUDI ARABIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of facilities	Annual capacity
Petrochemicals--Continued:				
Industrial ethanol		Saudi Petrochemical Co. (SADAF) (SABIC, 50%; Pecten Saudi Arabia, 50%)	Al Jubayl	300
Methyl-tertiary-butyl-ether/ Ethyl-tertiary-butyl-ether		do.	do.	700
Caustic soda		do.	do.	450
Methanol		National Methanol Co. (Ibn Sina) (SABIC, 50%; Celanese Arabian, 25%; Texan Eastern Arabian, 25%)	do.	900
Methyl-tertiary-butyl-ether		do.	do.	700
Methanol		Saudi Methanol Co. (Ar Razi) (SABIC, 50%; Japan Saudi Arabia Methanol Co., 50%)	do.	2,130
Ethylene glycol		Eastern Petrochemical Co. (SHARQ) (SABIC, 50%; Saudi Petroleum Development Corp., 50%)	do.	450
LLD Polyethylene		do.	do.	660
Ethylene-1 and 2		Arabian Petrochemical Co. (Petrokemya) (SABIC, 100%)	do.	1,150
Butene-1		do.	do.	100
Polystyrene		do.	do.	135
Propylene		do.	do.	300
Butadiene		do.	do.	100
Benzene		do.	do.	70
HAO Polyethylene		Al Jubayl Petrohemical Co. (Kemya) (SABIC, 50%; Exxon Chemical Arabia, Inc., 50%)	do.	170
HD Polyethylene		do.	do.	170
LLD Polyethylene		do.	do.	60
Methyl-tertiary-butyl-ether		Saudi European Petrochemical Co. (Ibn Zahr) (SABIC, 70%; Ecofuel, 10%; Neste Oy, 10%; Arab Petroleum Investments Corp., 10%)	do.	1,400
Polypropylene		do.	do.	800
Polyester fibers		Arabian Industrial Fiber Co. (Ibn Rushd) (SABIC, 48%; SAFCO, 10%; National Industrialization Co., 10%; other private interests, 32%)	Yanbu	140
Ethylene		Saudi Yanbu Petrochemical Co., (YANPET) (SABIC, 50%; Mobil Oil Corp, 50%)	do.	500
Ethylene glycol		do.	do.	220
Polyethylene		do.	do.	96
Petroleum, crude	million barrels	Saudi Aramco (Government, 100%)	Eastern Province, Najd Region, and offshore	3,600
Do.	do.	Arabian Oil Co., (AOC), (Japan Petroleum Trading Co., 80%; Kuwait, 10%; Saudi Arabia, 10%)	Khafji 2/	110
Do.	do.	do.	Al Hout 2/	10
Do.	do.	Saudi Arabian Texaco	Wafra, South Fawaris, South Umm Gudair 2/	50
Petroleum products		Saudi Aramco (Government, 100%)	Ras Tanura	110
Do	do.	Rabigh Petroleum Refining Co. (Saudi Aramco, 100%)	Rabigh	119
Do	do.	Jubail Petroleum Refining Co. (Saudi Aranco, 50%; Shell, 50%)	Al Jubayl	110
Do.	do.	Yanbu Petroleum Refining Co. (Saudi Aramco, 50%; Mobi 50%)	Yanbu	127
Do.	do.	Saudi Aramco (Government, 100%)	do.	69
Do	do.	Jiddah Oil Refinery Co. (Saudi Aramco, 100%)	Jiddah	38
Do.	do.	Riyadh Oil Refinery Co. (Saudi Aramco, 100%)	Riyadh	50
Do.	do.	Arabian Oil Co. (Japan Petroleum Trading Co., 80%; Kuwait, 10%; Saudi Arabia, 10%)	Al Khafji	11
Steel		Saudi Iron and Steel Co. (Hadeed)	Al Jubayl	2,700
Do.		(SABIC, 95%; DEG Corp., 05%)	Jiddah	245
Stone, dimension		Bin Laden Group (Private, 100%)	do.	450,000
Do.		Red Sea Minin p	do.	55,000
Do		Saudi Marble & Granite	Riyadh	50,000
Do.		Tinhat Co.	do.	50,000

See footnotes at end of table.

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TABLE 2--Continued
SAUDI ARABIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of facilities	Annual capacity
Titanium dioxide	The National Titanium Dioxide Co. (Cristal) (Shairco for Trading and Contracting, 25%; National Industrialization Co., 24%; Gulf Investment Corp., 24%; Kerr-McGee Chemical Corp., 25%; private individuals, 2%)	Yanbu	52
Zinc	Arabian Shield Company for Mining Industries (Arabian Shield Development Co., 50%; Al Mashreq Company for Mining Investments, 50%)	Al Masane	(3/)

1/ Natural gas is pumped through the Master Gas System to processing plants at Berri, Shedgum, and Uthmaniya where natural gas liquids are separated and sent by pipeline to fractionation plants at Ju'aymah and Yanbu.
2/ Partitioned Zone where production is shared between Saudi Arabia and Kuwait.
3/ Company holds a 30-year lease on 44 square kilometers with minable reserves of 7.2 million tons of ore containing zinc, copper, silver, and gold.

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THE MINERAL INDUSTRY OF

SYRIA

By Bernadette Michalski

In 1997, the mineral industry of Syria was dominated by the hydrocarbons sector, particularly with the development of nonassociated natural gas deposits in the north and northeast and the renewed interest in petroleum exploration. Other significant mineral industries include gypsum and phosphate rock mining, the manufacture of cement and fertilizers, and the manufacture of steel from domestic and imported scrap. The nation's gross domestic product (GDP) was approximately $14,000 million. Mining and manufacturing accounted for about 14% of the GDP in 1996, the last year for which data were available.

Industrial pollution was a major problem in all phases of Syrian industry. Homs, the site of a petroleum refinery and several fertilizer factories, is Syria's most industrially polluted city. Pollution is not limited to Homs, however, because as three-quarters of the thermal power stations throughout Syria burn fuel oil with a high sulfur content. The country's older cement factories, using wet-process kilns, are major polluters. Syria was in the early stage of developing its environmental awareness and was establishing a governmental structure for monitoring and protecting the environment. The Ministry of Environment has begun to introduce unleaded gasoline; there are, however, still no exhaust emission controls (U.S. Embassy, Amman, Jordan, 1998).

Crude oil production peaked in 1995 at 610,000 barrels per day (bbl/d). Production in 1997 averaged 561,000 bbl/d. The Al-Furat Petroleum Co., a joint venture among Syrian Petroleum Co., Royal Dutch/Shell, and Deminex, is the country's largest producer, yielding an average of approximately 350,000 bbl/d of Syrian Light (36.4° API) crude oil in 1997, down from a peak of 400,000 bbl/d. The Syrian Petroleum Co. produced 150,000 bbl/d of heavy Suwaydiyah 24° API) crude oil, and the Deir Es-Zor Petroleum Co. produced about 60,000 bbl/d of light crude oil. Details of Syrian mineral production are shown in table 1.

Exports of all goods in 1997 totaled nearly $4 billion in value, of which approximately $2 billion was derived from petroleum. Suwaydiyah crude oil averaged $15.40 per barrel compared with $17.74 per barrel in 1996. Syrian Light crude oil averaged $19.12 per barrel compared with $20.54 per barrel in 1996.

Export of Syria's other significant mineral product, phosphate rock, was nearly 2 million metric tons (Mt) in 1997, most of which was destined for Europe (Arab Petroleum Research Center, 1998).

Syria has a state socialist economic system with a growing private sector. In the mineral industry, however, private interests are only emerging in the cement, fertilizer, and power sectors. All mining, processing, and distribution companies are Government operated. Hydrocarbon exploration concessions, however, have been granted to foreign companies on behalf of the Syrian Government.

About 75% of Syria's cement requirements or about 5 Mt are met by the output from nine domestic plants. The largest of these is the Tartous Cement and Building Materials Co. with an annual cement production capacity of 2.1 Mt followed by the Al Shahba Cement and Building Materials Co. with 1.1 Mt. Increasing environmental considerations may force cement production to be concentrated in the larger and more-modern kilns and the smaller wet-process kilns are to be shut down.

Syria's fertilizer manufacturing industry is located at Homs. Two plants produce nitrogenous fertilizers, and the third produces phosphate fertilizer. A second phosphate plant was to be developed near Palmyra with phosphate feedstock delivered from the Khunaifis Mines, about 50 kilometers (km) south of Palmyra. This proposed 500,000-metric-ton-per-year (t/yr)-capacity triple superphosphate plant has undergone considerable delays; in October 1997, however, the Government announced that the triple superphosphate plant would be constructed. Syria plans to increase its phosphate output to 4 million metric tons per year (Mt/yr) by 2000 from 2.4 Mt/yr in 1997. Much of the increase is to be achieved by modernization of operations, including the introduction of new washing methods to improve quality (Mining Journal, 1997).

Natural gas production commenced its upward climb in 1997 as Syria's total natural-gas-processing capacity was increased to 5.9 billion cubic meters per year. Two new gas-processing plants came onstream in the Palmyra region in 1996 and 1997, and the Jbeisseh gas treatment plant was expanded by the installation of a second 1.2-million-cubic-meters-per-day (Mm^3/d) processing train. The expansion, completed early in 1997 will enable the plant to process natural gas from the Tel Audeh, the Kahtaniyal, and the Leylak Fields. At the same time, the capacity of the natural gas pipeline to Homs was doubled to 2.5 Mm^3/d through the installation of a booster station. Furthermore, 30 km of spur lines were laid to transport gas from the Jbeisseh-Homs gasline to Al Zara, near Hamah, where a gas-fired 800,000-t/yr steel plant and a 600- megawatt (MW) power station are under construction. The development of nonassociated gasfields west and north of Palmyra, including Al-Sharif, Al-Rasem, Al-Abbas, Kom Abu Arabat, Zamlakh, and Rasif, should raise Syria's dry natural gas production to about 5.8 billion cubic meters by 2000. Syria was also investigating the possibility of piping natural gas to Lebanon and Turkey. Gas pipeline projects tendered in early 1998 include a spur line from Baniyas to Beddawi in northern Lebanon where a 450-MW power station is under construction. Syria has agreed to provide at least 3 Mm^3/d to Lebanon for the power station (Middle East Economic Digest, 1998).

In early 1997, Elf Hydrocarbures, a subsidiary of Elf Aquitaine of France, signed a contract with the Syrian Petroleum Company for exploration and production rights to 4,200 square kilometers in northern Syria. Three-dimension seismic surveys were planned, and at least three exploration wells were to be drilled through 2000. Elf was operator of the permit with a 40% interest, with Sumitomo of Japan and Petronas of Malaysia each holding 30%.

The Al Khabour Petroleum Co. confirmed the commerciality of the Kishma Field in southeastern Syria. Initial production rate was

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5,000 bbl/d rising to 12,000 bbl/d by the close of 1997. Crude oil is transferred to an adjacent processing facility by tanker truck, and the processed crude oil will flow via pipeline to the Mediterranean port of Banias.

Syria operates the 135,000-bbl/d Banias and the 107,000-bbl/d Homs refineries at their effective capacities. The refineries process a 60%/40% mixture of light and heavy crudes. Fuel oil accounts for nearly 45% of output. Surplus products are exported to Cyprus and Lebanon, and domestic consumption requires the import of about 5 million barrels per year of middle distillates. Plans have been made to remedy this imbalance by adding a conversion unit at Banias and a 28,000-bbl/d catalytic cracker at Homs.

Proven recoverable natural gas reserves were 234.7 billion cubic meters as of January 1, 1998. About 127.7 billion cubic meters is nonassociated gas, 60.3 billion cubic meter is cap gas, and the remaining 46.7 is associated gas. Recoverable petroleum reserves are 2.5 billion barrels. Syria's known hydrocarbon reserves are concentrated in seven major fields, the largest of which was Suwaydiyah in the extreme northeastern section of the country. Proven reserves of this field alone were reported to be 1 billion barrels of liquid hydrocarbons and 5.6 billion cubic meters of natural gas (Arab Oil & Gas Research Center, 1998).

Railway transportation was available in northern and western Syria, servicing the major cities and the three principal ports of Baniyas, Latakia, and Tartous. The existing hydrocarbon pipelines include the Iraq Petroleum Co. (IPC) pipeline traversing Syria from east to west. The pipeline had been closed for Iraqi use since 1982; sections of the pipeline were, however, converted to domestic use. More than 100 km of the IPC pipeline were used for natural gas transmission, forming part of the 377-km pipeline from the Jbeisseh gas-processing plant to the fertilizer complex and refinery in Homs. Another section of the IPC line transported crude oil to the Homs refinery from the Al-Them, the Al Asmara, and Al Ward Fields, which were connected by spur lines to the main pipeline. With the onset of production, two spur lines were constructed that connected the Al Them Field along with its smaller satellite fields and the Uma Field to the IPC pipeline.

Syrian power-generation capacity has been increased in recent years to the point of meeting demand. Total electricity production topped 21 billion kilowatt hour in 1997 and is projected to reach 27.8 billion kilowatt hour by 2000. Six large power-plants were planned in the early 1990's, two of which have since come on-stream–the 600 MW Bandar power station in 1996 and the 375-MW gas-fired Al Nasiriyah power station in early 1997.

Syria's economic growth has slowed to less than 2% following a period of more-rapid growth in the early 1990's. Declines in foreign aid and private investment have been the main contributing causes. As petroleum reserves will be depleted in 12 years, at the present withdrawal rate, Syria will need increased exploration efforts to meet growing domestic demand and to maintain an export market that brings in about $1.5 billion to $2.0 billion per year. To this end, Royal Dutch/Shell, MOL Hungarian Oil Co., and Elf-Aquitaine won exploration contracts in 1997. The discovery of nonassociated natural gasfields and the increased use of associated natural gas was expected to reduce the demand for fuel oil and, thus, increase refined product export potential. The $600 million refurbishing of the two petroleum-refining facilities will probably bring the petroleum product mix industry more in concert with domestic requirements, thus improving Syria's balance of payments position. The growing availability of natural gas feedstock combined with ample reserves of phosphate are factors that will encourage Syria to continue development of its fertilizer industry and to expand its export potential.

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Major Sources of Information

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TABLE 1
SYRIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
Cement, hydraulic	thousand tons	4,500	5,000	4,463	5,000 e/	5,000
Gas, natural: e/						
Gross	million cubic meters	5,000	5,000	5,000	5,500 r/	6,400 2/
Dry	do.	2,800	2,800	2,900	3,000	4,560 2/
Gypsum		299,812	301,600	335,683	325,000 e/	325,000
Iron and steel, steel, crude e/		70,000	70,000	70,000	70,000	70,000
Natural gas liquids e/	thousand 42-gallon barrels	1,800	1,800	1,800	2,000 r/	2,250
Nitrogen:						
N content of ammonia		66,700	67,000	63,500 r/	80,400 r/	83,700 2/
N content of urea		30,000	54,500	28,700	46,000	54,400 2/
Petroleum:						
Crude		208,000	211,335	222,650	220,500	204,800 2/
Refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	1,800	2,000	2,100	2,122	2,170
Gasoline	do.	9,800	11,100	11,907	11,406	11,400
Naphtha	do.	5,000	3,000	1,676	1,685	1,700
Jet fuel	do.	4,500	3,000	1,753	1,728	1,725
Kerosene	do.	1,600	1,400	1,484	1,491	1,500
Distillate fuel oil	do.	25,000	27,000	29,951	30,078	30,600
Residual fuel oil	do.	35,000	35,000	34,891	35,038	35,000
Asphalt	do.	1,400	1,600	1,900	1,916	1,900
Other	do.	1,800	1,800	1,800	1,900	1,900
Total	do.	85,900	85,900	87,462	87,364	87,895
Phosphate rock:						
Gross weight	thousand tons	931	1,203	1,551	2,189	2,392
P_2O_5 content e/	do.	286	371	477 2/	670	730
Salt		113,000 e/	127,000 e/	111,000	72,000	70,000
Stone, sand and gravel: e/						
Stone, dimension, marble	thousand cubic meters	1,800	1,800	1,800	1,156 2/	1,150
Sand and gravel	thousand tons	4,200	4,200	4,200	4,200	4,200
Sulfur, byproduct of petroleum and natural gas e/		10,000	10,000	9,824 2/	10,000	10,000

e/ Estimated. r/ Revised.

1/ Table includes data available through November 1, 1998.

2/ Reported figure.

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THE MINERAL INDUSTRY OF

TURKEY

By Philip M. Mobbs

Turkey's economic crisis continued in 1997 owing to a combination of factors, such as public sector debt, rapid devaluation of the Turkish lira, a new Government, and associated high levels of political uncertainty, inflation, and unemployment (Barham, 1997). The primary mineral sector's contribution to the economy traditionally has been slightly more than 1% of the gross domestic product (GDP) that totaled about $191.5 billion[1] in 1997, value-added secondary mineral commodities, including refined petroleum products, steel, cement, glass, and certain inorganic chemicals, however were estimated to account for about 70% of the value of the nation's manufacturing output. Total (primary plus secondary) mineral industry revenues were estimated to be about 15% of the GDP.

The geology of Turkey is extremely complex and is reflected in the diversity of its mineral deposits. Best known for its industrial minerals, Turkey was a major producer of barite, boron minerals, celestite (strontium), emery, feldspar, limestone, magnesite, marble, perlite, and pumice. A wide variety of primary metallic minerals were produced as well. Chromite was the most significant mineral in the metal sector. Turkey was a major world producer of processed mineral commodities, including refined borates and related chemicals, cement, ceramics, and glass, and was a significant producer of ferrochromium and steel.

Government Policies and Programs

In 1997, the Turkish economy was burdened by inflation that had reached 99% on an annual basis, compared with an annual inflation rate of 80% in 1996. Despite the continued divestment of state-owned minerals sector holdings to domestic and foreign investors, the Government remained a significant factor in most sectors of the Turkish minerals industry through various parastatal (state-owned) industrial corporations and shareholdings in a number of private companies. The privatizations of most of the state's petroleum refineries, its remaining cement plant, and a number of electrical powerplants, in addition to the partial privatization of three steel plants, were under negotiation at yearend. The private sector component has continued to grow, especially since the passage of Mining Law No. 3213 in 1985. Hydrocarbon activities were regulated under Law No. 6326 of 1952, Law No. 6556 of 1955, Law No. 6987 of 1957, Law No. 1702 of 1973, and Law No. 2808 of 1983.

Environmental Issues

Rapid growth of industry, increasing urbanization of the population, and improved communications have led to increased awareness of and emphasis on environmental issues. Lignite was used in thermal powerplants that provided more than 50% of the country's electricity. Environmental, legal, and political considerations were affecting the Government's plans to address the growing electricity shortages in the country through the construction of new powerplants. Imported natural gas and liquefied natural gas (LNG) replaced lignite for domestic heating in the Ankara and the İstanbul metropolitan areas, thereby greatly reducing traditional wintertime air pollution. The gas pipeline network was being extended to other cities, and new pipelines to transport natural gas through eastern Turkey from Iran, Russia, and Turkmenistan were being considered.

Environmental issues have become a factor in Turkey's foreign relations. Proposed petroleum development in Kazakstan and other landlocked Turkic Republics pose the risk of oil spills or other shipping hazards if crude petroleum was to be pumped through the existing pipeline from Baku, Azerbaijan, to Novorossiisk, Russia, and then transshipped by supertankers via the Black Sea and the narrow Bosphorus and Dardanelles Straits. This path is currently the most economical transportation option. The Turkish Ministry of the Environment reported that during 1997, in addition to heavy local passenger ferry traffic, 50,492 ships passed through the Bosphorus and 35,543 ships transited the Dardanelles (Anadolu Ajansi, August 26, 1998, It is not like a strait but a motorway, accessed August 26, 1998, at URL http://www.turkishpress.com/aa/ index.html). As a crude oil transportation alternative, Turkey began construction of a 1,625-kilometer (km) pipeline from the eastern border to the Ceyhan oil terminal at Yumurtalık on the Mediterranean.

A major mining issue in Turkey was the local opposition to the development of gold mines near the tourist areas along the Aegean coast. The controversy centered over the use of sodium cyanide in heap-leaching extraction methods and the potential adverse impact on the farming and tourist industries if cyanide were to leak into the streams and aquifers. In October, an the Izmir administrative court annulled the Ministry of the Environment's "letter of non-objection" upon which subsequent permits at the Ovacık property had been issued.

Trade

As shown in table 1, Turkey produced a wide variety of mineral commodities. Mineral commodities accounted for about 12% of total exports, which were valued at $26.2 billion in 1997 compared with $23.2 billion in 1996. Turkey was a major exporter of steel and ferrochromium and exported limited quantities of chromite, copper, and zinc ores and refined metals. Aluminum exports increased to $205.8 million in 1997 compared with $179.4 million in 1996. Copper exports increased to $205.2 million in 1997 compared with $179 million in 1996. Jewelery exports, primarily gold, more than doubled to 1,130 metric tons (t) valued at $71.7

[1]Where necessary, values have been converted from Turkish lira to U.S. dollars at the rate of TL152,578=US$1.00 for 1997 and at the rate of TL81,699=US$1.00 for 1996.

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million in 1997 from 477 t in 1996 valued at $43.9 million. Iron and steel exports increased to 7.2 million tons (Mt) valued at $2.3 billion in 1997 compared with 6.6 Mt valued at $2.1 billion in 1996. Steel bars accounted for nearly 47% of Turkey's steel exports (İstanbul Ferrous and Non-Ferrous Metals Exporters' Association, 1998).

The United States was the major individual market, in terms of value, for Turkish metals in 1997, with imports valued at about $325 million, an increase of 96% from that of 1996. Singapore followed with metal imports valued at $288 million; Italy, $236 million; and Hong Kong, $199 million. Regionally, Europe and Central Eurasia received $1.02 billion; Asia and the Pacific, $718 million; and the Middle East, $612 million.

In contrast with metals, Turkey exported a wide variety of industrial minerals and derived chemicals, the value of which increased to $613 million in 1997 compared with $542 million in 1996. Ceramic products, glass, and glassware exports in 1997 were valued at $604 million compared with $512 million in 1996 (State Institute of Statistics, March 6, 1998, Provisional foreign trade figures—December 1997, accessed March 16, 1998, at URL http://www.die.gov.tr/ ENGLISH/SONIST/DISTICIST/060398.html).

Turkey's mineral imports were dominated by crude oil and refined mineral fuels valued at $6.1 billion, as well as a variety of metallic ores, steel, ferrous scrap, and other metals. The Turkish steel industry depended on imported scrap as feed for the country's many electric-arc minimills, and the unmet demand for flat steel products resulted in the valuation of iron and steel imports increasing to $2.71 billion in 1997 compared with $2.69 billion in 1996 (State Institute of Statistics, March 6, 1998, Provisional foreign trade figures—December 1997, accessed March 16, 1998, at URL http://www.die.gov.tr/ENGLISH/SONIST/DISTICIST/060398.html).

In December, setback to increased trade with Europe took place when the European Union (EU) approved a multiyear timetable for negotiating EU membership with 11 Central and Eastern European nations. Turkey, an associate member of the EU, was placed in a separate category, and proposed negotiation dates were not addressed.

Structure of the Mineral Industry

The mining sector has been estimated to comprise between 750 and 800 mining "establishments," a term roughly equivalent to "company" or "company division." These owned and/or operated about 3,000 mines. About 6,000 workshops processed gold jewelry.

Among the state-owned minerals corporations, the various subsidiaries of Etibank Genel Müdürlüğü dominated or produced the country's entire output of aluminum, boron minerals and chemicals, and ferrochrome. Turkish hard coal was mined by Türkiye Taşkömürü Kurumu Genel Müdürlüğü, and almost 90% of Turkey's total lignite output was accounted for by Türkiye Komur İşletmeleri Kumumu. About 78% of Turkey's total output of crude petroleum and all its natural gas were produced by Türkiye Petrolleri Anonim Ortaklığı (TPAO) and its subsidiaries. The pipeline company, Boru Hatları ile Petrol Taşıma A.Ş. (Botas), controlled virtually all the pipeline transport of mineral fuels. Türkiye Petrol Rafinerileri A.Ş. was by far the largest oil refiner in the country. Until recently, cement production was dominated by the parastatal Türkiye Çimento ve Toprak Sanayii T.A.Ş., but most of its plants have been successfully privatized.

Maden Tetkik ve Arama Genel Müdürlüğü was the state agency responsible for geologic exploration and research in Turkey.

Commodity Review

Metals

Aluminum.—In 1997, bids were requested for the expansion of Etibank's Seydişehir aluminum smelter from 60,000 metric tons per year (t/yr) to 100,000 t/yr. The $315 million contract for a 4-year smelter modernization and upgrade program was canceled by Etibank in September 1997, and a new request for bids was issued in November.

The expansion of the capacity at the Assan aluminum mill of Kibar Dis Ticaret A.Ş. from 20,000 t/yr to 70,000 t/yr continued during 1997 with the installation of two sheet mills. Kibar planned to commission the second sheet mill at the İstanbul mill early in 1998.

Chromite.—The Kromsan Plant of Soda Sanayii A.Ş., a member of the Türkiye Sise ve Cam Fabrikalari A.Ş. Group (Sisecam) began building a 6,000-t/yr chromic acid plant at Mersin. Chromic acid demand in Turkey was such that much of the production was to be exported.

Copper.—Karadeniz Bakır İşletmeleri A.Ş. (KBİ), Turkey's largest producer of copper ore and concentrates, was a candidate for privatization. At KBİ's Murgul operations, near Artvin, copper ore from the Çakmakkaya open pit was processed at the Çakmakkaya concentrator. The concentrate was sent via slurry pipeline to Hopa, dried, and shipped to the Samsun smelter. The Damar open-pit mine and concentrator and the 10,900-t/yr smelter at Murgul were not operational. Mining at the Kutlular Mine in Trabzon Province ceased in 1995 when the reserves were depleted. KBİ continued to explore the Kutlular area for economic copper deposits.

In addition to the concentrate feed produced at Murgul, KBİ processed domestic and imported copper concentrate at its 38,760-t/yr-capacity flash smelter at Samsun. The smelter also had a capacity to produce 282,000 t/yr of sulfuric acid from the smelter's offgases.

Etibank Küre Bakırlı Pirit İşletmesi Müessesesi Müdürlüğü was producing copper and pyrite concentrates at the mine at Küre. The company was winding down operations at the copper mine at Ergani because of depleted reserves.

To improve zinc recovery, Çayeli Bakir Isletmeleri A.Ş. added flotation cells to its ore- treatment circuit. In 1997, Çayeli produced and exported 29,000 t of copper in concentrate and 35,500 t of zinc in concentrate. The company initiated a limited exploration program near the mine.

Also mining copper were Ber-Oner Madencilik San. ve Tic. A.Ş. and Demir Export A.Ş. Cominco Madençilik Sanayi A.Ş., a subsidiary of Cominco Ltd. of Canada, was exploring the Agi Dagi copper prospect.

Turkey had an electrolytic copper production capacity of about 162,000 t/yr. Sarkuysan A.Ş., with a production capacity of 70,000 t/yr, was the country's leading copper refiner.

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Gold.—Eurogold Madencilik Ticaret ve Ltd. A.Ş., a joint venture of Mine Or S.A. of France (66.7%) and Inmet Mining Corp. of Canada (33.3%), continued to have problems at the Ovacık prospect, near Bergama. Eurogold completed construction of the $49 million operation in December 1997 despite a month-long suspension of activity in April triggered by protests concerning the proposed use of sodium cyanide. Legal problems continued to entangle the property when the Izmir administrative court ruled to annul the Ministry of the Environment's "letter of non-objection". The final operating certificate was pending at yearend. Eurogold was also exploring the Mastra property.

The permitting uncertainties encountered by Ovacık also affected other proposed gold projects in Turkey. Additionally, because of the drop in the price of gold during 1997, Tüprag Metal Madencilik San. ve Tic. Sti., a subsidiary of Eldorado Gold Corp. of Canada, revised the feasibility and environmental studies of its Küçükdere prospect. Tüprag completed the feasibility study on the Kaymaz deposit and began pre-feasibility work on the Efemçukuru (WT) project. Tüprag also acquired the Kisladag gold prospect and began exploration of the deposit in 1997.

Yeni Anadolu Mineral Madencilik San. ve Tic. Ltd. Sti., a subsidiary of Anatolia Minerals Development Corp. of the Cayman Islands, was exploring for gold on the Armutbeli, Black Sea Region, Keban, Saimbeyli, Yenipazar, and Yolustu-Atizi Properties. At year-end, Woodco Resources Inc. of Canada was engaged in a take-over bid of Anatolia.

Steel.—In 1997, Turkish total crude steel production reportedly increased slightly to 13.6 Mt despite reduced world market demand. Ereğli Demir ve Çelik Fabrikaları T.A.Ş. (Erdemir) was the sole flat products producer. Erdemir embarked on a new two-stage production capacity expansion in 1997. The initial $2.2 billion segment would expand production capacity from 3 million metric tons per year (Mt/yr) to 4.5 Mt/yr. The attempted partial divestment of the state's interest in Erdemir was thrown out by the Ankara administrative court. During 1997, the state proposed privatisation of Türkiye Demir ve Çelik İsletmeleri Genel Müdürlüğü amd Sivas Demir-Çelik İsletmeleri A.Ş. Sivas has been idled since December 1996.

Çukurova Çelik Endüstrisi A.Ş. installed a 600,000-t/yr-capacity rolling mill in 1997 and began the expansion of its crude steel production capacity.

Industrial Minerals

Barite.—As part of the company's preparations for the production of micronized barite, Başer Maden Sanayi ve Ticaret A.Ş. renovated its washing and screening plant and installed two ball mills. Micronized barite production capacity was projected to be 8,000 t/yr. Başer's plant at Sarkikaraagac, near Isparta, had a barite grinding capacity of 90,000 t/yr and was fed by production from the company's 120,000-t/yr-capacity mining operations. In 1997, the company also completed a treatment plant to recover up to 25,000 t/yr of filler-grade barite from an accumulated resource of 500,000 t of barite slimes.

Boron.—Etibank increased run-of-mine boron production to 2.6 Mt in 1997 compared with 2.4 Mt in 1996 and 1.8 Mt in 1995. Etibank produced a significant proportion of the world's boron.

Cement.—Rumeli Çimento Sanayi ve Ticaret A.Ş. acquired Ergani Çimento San. Tic. A.Ş. from the Privatisation High Council for $46.7 million. Bids for Kurtlan Çimento San. Tic. A.Ş. were not accepted, leaving it as the only remaining Government-owned cement plant. The Government had owned 24 cement plants prior to the divestments beginning in 1989.

The Set Group reorganized its Turkish cement operation, combining Set Ankara Çimento Fabrikası, Set Balikesir Çimento San. ve Tic. A.Ş., and Set Trakya Çimento Fabrikası to form Set Çimento Sanayi ve Ticaret A.Ş. Set increased its interest in Set Afyon Çimento San. ve Tic. A.Ş. from 53% to 73%. Also in 1997, the Set Group discontinued the production of clinker at Set Anadolu Çimentorali Ticaret A.Ş. in Kartal, 20 km east of İstanbul, and installed a 700,000-t/yr crushing plant at its Ambarlı marine terminal.

Clay.—Kale Madencilik Endüstriyel Hammaddeleri San. ve Tic. A.Ş. commissioned a 40,000-t/yr kaolin processing plant. Kale Madencilik was primarily an exporter of ceramic raw materials with an annual raw clay production capacity of about 2.5 Mt.

Feldspar.—Esan Eczacıbaşı Endüstriyel Hammaddeleri San. ve Tic. A.Ş. installed an additional sodium feldspar flotation unit. The company had a crushing capacity of about 530,000 t/yr. Kale Madencilik had a production capacity of 400,000 t/yr of sodium feldspar in addition to 20,000 t/yr of potassium feldspar. During 1997, Kaltun Madencilik Ticaret A.S. added new drying, screening, and magnetic separation units to its plant. Matel Hammaddeleri San. ve Tic. A.Ş., Toprak Madencilik, and four other companies also produced feldspar in Turkey (Bozdogan, 1997).

Glass.—A major producer of glass products was the Sisecam Group, which accounted for about 1.5% of the world's glass supply (Sims, 1997). The Group included Camiş Madencilik A.Ş., a mining company; Soda Sanayii A.Ş., a soda ash/chromium chemicals producer; three flat glass producers; two glass container companies; three glassware producers; and a cast iron company. The company continued a modernization and capacity expansion program in 1997, with the renovation of the Number 1 float line at Trakya Cam Sanayii and the installation of a second furnace at the Mersin glassware plant of Pasabachçe Cam San. ve Tic. A.Ş. The Group's Anadoul Cam Sanayii operation, plant Number 10 was rebuilt, and a new glass plant was commissioned. Total glass production capacity for the company was 1.4 Mt at yearend. The company exported primarily to Europe (57% of the company's production) and the Far and Middle East (22%).

Magnesite.—Despite the drop in Turkey's magnesite production and the cancellation of the November 1996 privatization tender of Konya Krom Magnezit Tuğla Sanayii A.Ş. after the Government received only one bid for the company, there was a burst of activity in the raw magnesite operations sector. Comag Continental Madencilik Sanayii Tic. A.Ş. began commercial operations at its $3 million, 120,000-t/yr raw magnesite preparation plant in Eskişehir. Plant feed was to be supplied by the Kümbet-Eskişehir Mines. Kümas-Kütahya Manyezit Isletmeleri A.Ş. continued the installation of a crushed magnesite screening operation with five sizers being installed in

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mid-1997.

Soda Ash.—Soda Sanayii A.Ş., a member of the Sisecam glass group, increased its soda ash production capacity to 633,000 t/yr from 613,000 t/yr in 1997. The company planned to complete the production capacity expansion to 750,000 t/yr in 1998.

Mineral Fuels

Although the Government has been promoting the consumption of natural gas as a clean-burning substitute for lignite, Turkish natural gas reserves were considered to be inadequate to supply demand, estimated to be from 6 billion to 8 billion cubic meters per year of natural gas (Middle East Economic Digest, 1995). Turkey has been importing about 6 billion cubic meters per year of natural gas from Russia via a pipeline through Bulgaria, Romania, and Ukraine, but the amount of gas supplied by this route also was considered to be insufficient to meet long-term demand, which was expected to increase significantly. In 1997, Turkey signed an agreement to import an additional 24 billion cubic meters per year from Russia for 25 years and agreed to import 3 billion cubic meters per year from Turkmenistan.

Turkey was importing LNG from Algeria and Australia via the 6-billion-cubic-meter-per-year-capacity LNG storage and regasification plant at Marmaraereğlisi. Botas had contracted to import LNG from Nigeria and natural gas from Iran, Egypt, Qatar, and Yemen, primarily under long-term contracts starting in 1999.

With 631 active wells, TPAO accounted for about 77% of domestic oil production (Türkiye Petrolleri Anonim Ortaklığı, 1998, Petroleum activities in Turkey, accessed February 1, 1999, at URL http://www.tpao.gov.tr/rprte/activities.htm). Most of Turkey's oil exploration and production were in the southeastern region where the armed rebel Kurdish Workers Party was operative. In 1997, TPAO drilled about 43 wells, of which 2, Lilan-1 and Eskitaş-1 in the Adıyaman Region, were field discoveries. Other operators drilled an additional 12 wells in Turkey. TPAO brought the Kuzey Marmara natural gas field, its first offshore gasfield, on-stream in October. The five-well platform was in 43 meters of water.

About 138 million barrels per year (Mbbl/yr) of Iraqi oil was exported through Turkey's Ceyhan oil terminal in 1997 under the United Nations oil-for-food exchange program (Resolution 986). In addition to normal imports, an estimated 11 Mbbl/yr of diesel fuel was reportedly brought across the border from Iraq into Turkey at Habur (Washington Times, 1995).

Reserves

Turkey's mineral inventory is diverse and large, but many of the deposits, especially for metallic minerals, are small by world standards (Erseçen, 1989). Resources of metallic commodities minable by large-scale methods are known for bauxite, chromite, copper and copper-zinc, gold, iron, and silver. Turkey is better known for its deposits of industrial minerals, most significant of which are barite, boron, clays, limestone and marble, magnesite, perlite, pumice, strontium, and trona. The country has large lignite reserves. The crude oil reserves of about 330 million barrels were hosted in a large number of small fields. Natural gas reserves were estimated at 9.3 billion cubic meters (Turkish Daily News, July 28, 1998, Turkey's oil reserves diminish, accessed July 29, 1998, at URL http://www.turkishdailynews.com/free_daily_tdn/latest/econ.htm).

Infrastructure

Turkey's extensive road and railroad infrastructure was heavily used for the transport of mineral commodities. Turkey had 2,092 km of crude petroleum and 2,321 km of refined petroleum products pipelines. The longest stretch of pipeline was the 641-km twin line connecting Iraq with the Ceyhan oil-loading facility at Yumurtalık. Ceyhan was also the terminus for a 447-km pipeline to the refinery in Kırıkkale. The oil port at Dörtyol, 28 km north of İskenderun, was the terminus of a 494-km pipeline from the oil refinery at Batman, with shorter spurs from this line to the oilfields near Batman (Şelmo) and around Adıyaman. Turkey had about 900 km of natural gas pipeline, which was used to import natural gas from Russia.

The new Russian natural gas supplies were to be transported via a $13.5 billion, 1,200-km pipeline to be built through the Black Sea from Izobilnoye, Russia, to landfall at Samsun, Turkey, and on to Ankara. Two Turkmen gas pipeline routes were proposed—one through Iran, and the other through Azerbaijan.

Turkey had many ports capable of handling mineral commodity shipments. Major coal-importing ports included İskenderun and Ereğli. Chromite was shipped from various Anatolian ports on the Marmara coast, as well as from Antalya and İskenderun, which handled all Turkey's ferrochrome exports. Iron ore, steel, and steel scrap imports also were handled at many ports, particularly Aliağa, Ereğli, İskenderun, and Mersin and at various sites in the İstanbul-İzmit area. Turkey's boron minerals and chemicals were exported from Bandırma. Copper concentrates, ore, and blister were shipped from Samsun, and copper concentrates, from Hopa, Rize, and İskenderun. Marine terminals at Ambarlı were used to ship cement.

Because electrical power demand has been growing at an estimated 8% to 10% per year, Turkey was in the process of greatly expanding its electrical generating capacity. The Government planned to privatize existing hydroelectric and thermal powerplants through operation and maintenance leases and to have new hydroelectric, nuclear, and thermal powerplants built by the private sector. In October 1997, the Government leased eight thermal plants with an electrical generating capacity of 4,269 megawatts for $1.24 billion. The leases were under review by the Danıştay, the administrative court that rules on privatization and build-own-transfer power station contracts.

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TABLE 1
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
METALS						
Aluminum:						
Bauxite 2/		538,439	445,020	232,278	544,513	373,397 3/
Alumina:						
Gross weight		169,195	155,299	171,978	159,298	164,333 3/
Al content		88,195	80,952	91,000 e/	83,000 e/	86,000
Metal, smelter		58,503	59,750	61,514	60,000 e/	62,019 3/
Antimony:						
Ore, mine output:						
Gross weight		2,100	1,415	7,856	5,384 r/	5,000
Sb content		111	75	416	285 r/	250
Concentrates:						
Gross weight		93	90 e/	1,163	700 r/	500
Sb content		59	55 e/	291	175 r/	125
Cadmium		31	22	23 e/	42 r/	45
Chromite:						
Gross weight (34% to 43% chromic oxide)		767,313	1,270,431	2,080,043	1,279,032 r/	1,863,878 3/
Salable product		642,376	501,851	1,460,000 e/	1,171,000 e/	1,300,000
Copper:						
Mine output (exclusive of pyrite):						
Gross weight		3,343,532	3,346,490	3,185,628	3,518,754 r/	3,181,515 3/
Cu content of ore		39,163	34,902	40,085	33,792 r/	35,000
Cu content of pyrite e/		350	350	2,100	3,800 r/	2,500
Concentrates (exclusive of pyrite):						
Gross weight		140,165	139,919	141,000 e/	133,350 r/	130,000
Cu content		23,879	28,891	24,000 e/	29,580 r/	25,000
Metal:						
Smelter output (primary + secondary)		39,638	30,400	33,700 e/	38,600 e/	32,491 3/
Refined e/		92,400	82,700	98,500	120,000	120,000
Gold, byproduct of base metals refining e/ 4/	kilograms	1,110	996	1,200	1,000 r/	1,000
Iron and steel:						
Iron ore:						
Gross weight	thousand metric tons	6,480	5,755	4,931	6,404	6,321 3/
Fe content e/	do.	3,324	3,148	2,750	3,500	3,500
Metal:						
Pig iron and ferroalloys:						
Ferrochromium		90,030	97,585	94,251	101,450	95,000
Ferrosilicon		4,680	4,930	4,900	4,460 r/	4,500
Pig iron and other ferroalloys	thousand metric tons	4,353	4,604	4,363	5,263	5,567 3/
Steel, crude including castings	do.	11,838	12,074	12,744	13,382	13,644 3/
Lead:						
Mine output, Pb and Pb-Zn ores:						
Gross weight		179,731	232,140	253,100	234,541 r/	261,968 3/
Pb content		11,448	11,158	10,376	10,971 r/	12,000
Concentrates:						
Gross weight		8,021	5,683	5,318	4,494 r/	6,000
Pb content		2,571	1,279	1,196	3,140 r/	3,500
Metal, refined e/		5,000	5,100	4,000	4,000	7,000
Manganese ore, gross weight 5/		37,491	34,500	37,000 r/	37,000 e/	35,000
Silver, mine output, Ag content e/ 6/	kilograms	103,000	65,000	70,000	70,000	90,200
Zinc:						
Mine output, Zn and Pb-Zn ore:						
Gross weight		231,756	297,252	73,110	104,819 r/	91,754 3/
Zn content		20,500 e/	26,300 e/	9,118	14,921 r/	12,500
Concentrates: e/						
Gross weight		23,000	30,000	9,760	9,981 r/ 3/	9,200
Zn content		8,000	10,000	5,774 3/	5,529 r/ 3/	5,000
Metal, smelter, primary		18,500	18,567	17,050	22,392 r/	35,000

See footnotes at end of table.

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TABLE 1--Continued
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
INDUSTRIAL MINERALS						
Aluminum sulfate (alunite)		13,500	12,165	9,763	6,625 r/	6,600
Barite, run of mine		118,367	116,220	153,719	104,872 r/	140,872 3/
Boron minerals:						
Run of mine		1,892,356	2,092,032	1,768,919	2,400,635 r/	2,606,267 3/
Concentrates		1,079,135	1,139,980	1,143,994	1,446,697 r/	1,600,000
Cement, hydraulic	thousand metric tons	31,241	29,493	33,153	35,214	36,035 3/
Clays:						
Bentonite		456,597	516,187	602,499	515,452 r/	500,000
Kaolin		210,356	179,775	489,635	449,561 r/	500,000
Other		665,351	956,012	1,649,192	6,405,377 r/	6,400,000
Emery		10,988	12,000	14,149	11,092 r/	12,000
Feldspar, run of mine		366,166	502,608	760,250	910,814 r/	900,000
Fluorspar		4,000 e/	6,671	8,873	4,828 r/	5,000
Glass, crude e/	thousand metric tons	1,300	1,300 r/	1,150 r/	1,133 r/ 3/	1,369 3/
Gray hite, run of mine e/		20,000	20,000	20,000	20,000	15,000
Gypsum, other than that for cement		492,705	596,962	596,967	754,277 r/	700,000
Lime 7/	thousand metric tons	1,767	1,800 e/	897	1,023 r/	1,000
Magnesite, run of mine		525,640	1,279,614	1,928,064	2,339,138 r/	1,409,768 3/
Meerschaum	kilograms	3,050	2,350	1,000	500	400
Nitrogen, N content of ammonia		325,800	350,000 e/	366,000	518,800 e/	558,000 e/
Perlite, run of mine		147,864	164,582	171,058	157,580 r/	160,000
Phosphate rock (salable product)		77,671	--	--	--	--
Pumice 8/		1,224,114	947,174	1,125,820	774,000 r/	800,000
Pyrites, cupreous, gross weight		50,000 e/	50,000 e/	307,992	538,140 r/	350,000
Silica sand, gross weight 9/	thousand metric tons	506	741	755	779	1,253 3/
Sodium compounds:						
Salt, NaCl, all types	do.	1,526	1,353	1,444	2,068 r/	2,000
Soda ash (trona) e/	do.	385	385	385	400	500 3/
Sodium sulfate, concentrates		170,680	307,049	314,192	328,953 r/	300,000
Stone:						
Dolomite		376,518	378,004	425,877	981,683 r/	900,000
Limestone, other than for cement	thousand metric tons	10,852	11,000 e/	20,496	40,456 r/	40,000
Marble e/	do.	730	750	272	1,287 r/	1,500
Quartzite		1,205,694	1,350,299	1,364,558	2,807,279 r/	2,800,000
Strontium minerals, celestite: e/						
Run of mine		68,000	45,000	50,000	50,000	50,000
Concentrates		43,700	25,000	30,000	30,000	30,000
Sulfur: e/						
Native, other than Frasch		17,400	16,673 3/	17,000	--	--
S content of pyrites		26,758 3/	27,000	163,000 r/	255,000 r/	186,000
Byproduct:						
Petroleum		21,000 3/	25,000	26,000	25,000	20,000
Other		5,000	5,000	20,000 r/	25,000 r/	20,000
Total		70,158	73,673	226,000 r/	305,000 r/	226,000
Talc e/		4,000	4,000	4,000	4,000	4,000
MINERAL FUELS AND RELATED MATERIALS						
Asphalt, natural		309,348	108,364	219,848	126,751	125,000
Carbon black e/		34,878 3/	35,000	39,975	39,273 r/	39,000
Coal:						
Hard coal, run of mine	thousand metric tons	4,609	4,211	3,377	3,582 r/	4,366 3/
Lignite, run of mine	do.	51,359	55,038	56,031	57,532 r/	58,168 3/
Coke and semicoke	do.	2,899	2,799	3,021	2,297 r/	3,186 3/
Gas:						
Natural, marketed	thousand cubic meters	199,739	198,630	181,515	203,967	250,804
Coal, manufactured e/	do.	35,000	35,000	35,000	37,000	35,000

See footnotes at end of table.

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TABLE 1--Continued
TURKEY: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity		1993	1994	1995	1996	1997 e/
MINERAL FUELS AND RELATED MATERIALS--Continued						
Petroleum:						
Crude	thousand 42-gallon barrels	27,871	26,399	24,124	25,015 r/	24,509 3/
Refinery products:						
Liquefied petroleum gas	do.	8,197	8,503	9,185	9,580	9,265 3/
Gasoline	do.	27,808	29,521	31,746	30,950	33,607 3/
Naphtha	do.	10,617	10,761	12,110	13,227 r/	13,473 3/
Jet fuel	do.	9,015	10,380	12,119	11,324	13,477 3/
Kerosene	do.	1,282	819	605	726	560 3/
Distillate fuel oil 10/	do.	54,103	55,197	59,556	55,838	55,249 3/
Lubricants e/	do.	2,000	2,000	2,000	2,000	800
Residual fuel oil	do.	57,981	50,640	52,043	49,459	48,012 3/
Asphalt	do.	7,812	5,389	5,940	7,233	8,029 3/
Unspecified e/ 11/	do.	6,700	6,700	6,700	4,000	2,500
Total	do.	185,515	179,910	192,004	184,337 r/	184,972

e/ Estimated. r/ Revised.

1/ Table includes data available through January 7, 1998. Large quantities of construction materials (clay, sand and gravel) are quarried. Also quarried are basalt, diabase, granite, onyx, sandstone, serpentine, slate, and travertine for building stone and limestone and gypsum for cement manufacture; information is, however, inadequate to make estimates of output levels.

2/ Data are for public sector only. Data for private-sector production are not available, but production is believed to be approximately 30,000 metric tons per year.

3/ Reported figure.

4/ Data are estimated content of Turkish copper refinery tankhouse slimes.

5/ Does not include manganiferous iron ore from the Deveci Mine, production of which amounts to several hundred thousand tons per year and has a manganese content of 3% to 5%.

6/ Includes estimated content of base metals refinery tankhouse slimes.

7/ Data are lime produced for steel production and do not include the widespread artisanal production of lime for whitewash and sanitation purposes.

8/ Turkish pumice production is officially reported in cubic meters and has a density reported to range from 0.5 to 1.0 metric ton per cubic meter. Values in this table have been converted by using 1 cubic meter=0.75 ton.

9/ Previously reported as estimated production of washed silica sand, in metric tons: 1993--350,000; 1994--415,000; 1995--310,000; and 1996--385,000.

10/ Diesel fuel and special heating oil.

11/ Includes refinery fuel and losses.

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TABLE 2
TURKEY: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners[1,2]	Location of main facilities	Annual capacity
Aluminum and bauxite	Etibank Milas Boksit İşletmeleri Müdürlüğü (Etibank, 100%)	Open pit mine at Milas, 127 kilometers southwest of Denizli	150 diaspore.
Do.	Etibank Seydişehir Alüminyum Tesisleri Müessesesi Müdürlüğü (Etibank, 100%)	Doğankuzu and MortaŞ bauxite mines at Madenli, 25 kilometers south of Seydişehir	450 bauxite.
Do.	do.	Alumina refinery and aluminum smelter at Seydişehir	200 alumina, 60 aluminum.
Barite	Barit Maden Türk A.Ş.	Mines near Sivas and Adana	220 ground barite.[3]
Do.	Baser Maden Sanayi ve Ticaret A.Ş.	Mines at Isparta and Konya	90 ground barite.
Do.	Emas Endüstri Mineralleri A.Ş.	Mine at Muş	100 ground barite.
Do.	Etibank Beyşehir Barit İşletmesi (Etibank, 100%)	Mine at Beyşehir, 72 kilometers southwest of Konya	70 barite ore.
Do.	Antalya Elektrometalurji Sanayi İşletmesi Müessesesi Müdürlüğü (Ado Mining, 100%)	Grinding plant at Antalya	100 ground barite.
Do.	Polbar Barit Endüstrisi A.Ş.	Mine near Antalya	120 ground barite.
Boron minerals	Etibank Bigadiç Madencilic İşletmeleri (Etibank, 100%)	Bigadiç, 38 kilometers southeast of Balıkesir	400 colemanite concentrate, 128 ulexite concentrate.
Do.	Etibank Emet Kolemanit İşletmeleri (Etibank, 100%)	Espey and Hisarcık Mines near Emet, 62 kilometers west-southwest of Kütahya	500 colemanite concentrate.
Do.	Etibank Kestelek Kolemanit İşletmeleri (Etibank, 100%)	Kestelek, 80 kilometers west-southwest of Bursa	100 colemanite concentrate.
Do.	Etibank Kırka Boraks İşletmeleri Müessesesi Müdürlüğü (Etibank, 100%)	Kırka, 61 kilometers north of Afyon	600 tincal concentrate.
Cement	Adana Çimento Sanayii T.A.Ş. (Ordu Yardimlasma Kurumu Genel Müdürlüğü, 48.74%)	12 kilometers east of Adana	3,643.
Do.	Akçansa Çimento Sanayi ve Ticaret A. Ş. (Sabanci Holdings Group, 50%; Cimenteries CBR S.A., 50%)	Büyükçekmece, 30 kilometers west of İstanbul and Mahmudiye, 40 kilometers south of Çanakkale	6,000.
Do.	Aslan Çimento A.Ş. (Laf4arge Coppée, 86%)	Darıca, 40 kilometers southeast of İstanbul	1,600.
Do.	Batı Anadolu Çimento Sanayii A.Ş.	Bornova, 10 kilometers northeast of İzmir	1,800.
Do.	Bolu Çimento Sanayii A.Ş.	Çaydurt	2,100.
Do.	Çimento Sanayi ve Ticaret A.Ş. (Sabanci Holdings A.Ş.)	Mersin and Kayseri	2,700.
Do.	Nuh Çimento Sanayii A.Ş.	Near Hereke 30 kilometers west of İzmit	3,750.
Do.	Rumeli Çimento Sanayi ve Tic. A.Ş.	Bartın, Ergani, Gaziantep, Ladik, Trabzon, and Şanlıurfa plants	5,000.[e]
Do.	OYAK Group	4 plants	2,280.
Do.	Set Çimento Sanayi ve Ticaret A.Ş. (Soc. des Ciments Français, 100%)	Ankara, Balıkesir and Trakya plants	2,980.
Do.	Türkiye Çimento ve Toprak Sanayii T.A.Ş. (ÇİTOSAN) (Government, 100%)[4]	Kurtlan	510.
Do.	Yibitaş Lafarge Group (Yibitaş Holdings A.Ş., 50%; Lafarge Coppée, 50%)	Ankara, Çorum, Sivas and Yozgat plants	2,473.

See footnotes at end of table.

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TABLE 2—Continued
TURKEY: STRUCTURE OF THE MINERAL INDUSTRY FOR 1997

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners[1 2]	Location of main facilities	Annual capacity
Chromium:			
Chromite ores and concentrates	Etibank Şark Kromları İşletmesi Müessesesi Müdürlüğü (Etibank, 100%)	Mines at Güleman, 40 kilometers southeast of Elazığ	150 lump ore, 70 concentrate.
Do.	Etibank Üçköprü Maden İşletmesi Müessesesi Müdürlüğü (Etibank, 100%)	8 mines in Göcek District, west of Fethiye	15 lump ore, 30 concentrate.
Do.	Birlik Madencilik Ticaret ve Sanayi A.Ş.	Mines in Kayseri, Erzurum, and Erzincan Provinces	240 lump ore.
Do.	Akpaş Madencilik ve Paz. ve Ticaret A.Ş.	Mines in Erzurum, Erzincan, and Kayseri Provinces	200 lump ore, 70 concentrate.
Do.	Bilfer Madencilik A.Ş.	Mines in Kayseri and Sivas Provinces	350 lump ore,
Do.	Türk Maadin Şirketi A.Ş.	Mines at Köyceğiz, 56 kilometers northwest of Fethiye, and at Eskişehir	24 lump ore, 88 concentrate.
Do.	Dedeman Madencilik Turizm Sanayi ve Ticaret A.Ş.	Kayseri Province	120 lump ore.
Do.	Egemetal Madencilik A.Ş.	Mines in Bursa, Mersin, Eskişehir, and Erzurum Provinces	250 lump ore, 40 concentrate.
Do.	Pinar Madencilik ve Turizm A.Ş.	Mines in Kayseri and Adana Provinces	25 lump ore, 14 concentrate.
Do.	Akdeniz Madencilik Ticaret ve Sanayi A.Ş.	Adana	25 lump ore.[e]
Do.	Other private producers (9)	Mines in Köyceğiz, Bursa, Adana İskenderun, and Eskişehir Provinces	114 lump ore, 12 concentrate.
Ferrochrome	Etibank Elazığ Ferrokrom İşletmesi (Etibank, 100%)	Ferrochrome smelter, 50 kilometers east of Elazığ	150 high-carbon ferrochrome.
Do.	Etibank Antalya Elektrometalurji Sanayi İşletmesi Müessesesi Müdürlüğü (Etibank, 100%)	Ferrochrome smelter at Antalya	11 low-carbon ferrochrome.
Coal:			
Hard coal	Türkiye Taşkömürü Kurumu Genel Müdürlüğü (TTK) (Government, 100%)	Coalfields near Zonguldak	7,000.[e]
Lignite	Türkiye Kömür İşletmeleri Kurumu (TKİ) (Government, 100%)	Mines throughout Turkey	50,000.[e]
Do.	Private-sector producers	About 200 small mines throughout Turkey	9,000.[e]
Copper	Etibank Küre Bakırlı Pirit İşletmesi Müessesesi Müdürlüğü (Etibank, 100%)	Open pit copper and pyrite mine at Küre, 14 kilometers south of İnebolu	55 copper concentrate, 460 pyrite concentrate.
Do.	Çayeli Bakır İşletmeleri A.Ş. (Inmet Mining Corp., 49%; Etibank, 45%; Gama Endustri, 5%; and Gama Holding, 1%)	Çayeli Mine, 85 kilometers east of Trabzon	29 copper concentrate.
Do.	Karadeniz Bakır İşletmeleri A.Ş. (Etibank, 99.97%)[4]	Çakmakkaya mining operations and concentrator at Murgul near Artvin	132 copper concentrate 130 pyrite concentrate.
Do.	do.	Damar mining operation and concentrator at Murgul	37 copper concentrate, 35 pyrite concentrate.[3]
Do.	do.	Smelter at Murgul	11 blister copper.[3]

See footnotes at end of table.

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TABLE 2—Continued
TURKEY: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Major commodities	Major operating companies and major equity owners[1 2]	Location of main facilities	Annual capacity
Copper—Continued:	Karadeniz Bakır İşletmeleri A.Ş (Etibank, 99.97%)[4]	Smelter and acid plant at Samsun	39 blister copper.
	Sarkuysan Elektrolitik Bakır Sanayii ve Ticaret A.Ş.	Gebze, 40 kilometers west of Izmit	70 refined copper.
Do.	Rabak Elektrolitik Bakır ve Mam. A.Ş.	İstanbul	35 refined copper.
Do.	Hes Kablo	Kayseri	31 refined copper.[5]
Iron and steel:			
Iron ore	Türkiye Demir ve Çelik İşletmeleri Genel Müdürlüğü (TDÇI) (Government, 100%)	Divriği Mines, 115 kilometers northwest of Elazığ	3,000 ore;[e] 1,100 pellets; 600 concentrate; 500 lump ore.
Do.	do.	Deveci Mine at Hekimhan, 112 kilometers west of Elazığ	750 ore.[e]
Do.	Bilfer Madencilik A.Ş.	Mines near Divriği	1,500 ore.
Steel	Ereğli Demir ve Çelik Fabrikaları T.A.Ş. (Erdemir) (Government, 51.66%;[4] others, 48.34%)	Ereğli	3,000 crude steel.
Do.	Türkiye Demir ve Çelik İşletmeleri Genel Müdürlüğü (TDÇI) (Government, 100%)[4]	İskenderun	2,200 crude steel.
Do.	Karabük Demir ve Çelik A.Ş. (Employees, 52%)	Karabük	1,000 crude steel.
Do.	Çolakoğlu Metalurji A.Ş.	Gebze, 40 kilometers west of İzmit	650 crude steel, 1,050 semifinished steel.
Do.	Çukurova Çelik Endüstrisi A.Ş.	Aliağa, 40 kilometers north-northeast of İzmir	2,000 semifinished steel.
Do.	Diler Demir Çelik Endüstri ve Ticaret A.Ş.	İzmit	310 semifinished steel.
Do.	Ekinciler Demir ve Çelik Sanayi A.Ş.	Arc furnace and rolling mill at İskenderun. Rolling mills at Adana, Karabük, and near İskenderun (Payas)	600 semifinished steel.
Do.	Habaş Sinai ve Tibbi Gazlar İstihsal Endüstrisi A.Ş.	Aliağa	do.
Do.	İzmir Demir Çelik Sanayi A.Ş. (İDÇ) (İş-Bakansi, 60%)	do.	550 semifinished steel.
Do.	Kroman Çelik Sanayii A.Ş.	Gebze, 40 kilometers west of İzmit	420 semifinished steel.
Do.	Metaş İzmir Metalurji Fabrikası T.A.Ş.	İzmir	450 special and semifinished steel.
Do.	Sivas Demir-Çelik İşletmeleri A.Ş. (Government, 99.98%)[4]	Sivas	400 semifinished steel.[3]
Magnesite	Konya Krom Magnezit Tuğla Sanayii A.Ş. (Government, 100%)[4]	Konya	40 dead-burned magnesite, 38 bricks, 20 mortar.
Do.	Kümaş-Kütahya Manyezit İşletmeleri A.Ş. (Zeytinoğlu Holding A.Ş., 97.44%)	Kütahya	144 dead-burned magnesite, 46 bricks.
Do.	Comag Continental Madencilik Sanayii Tic. A.Ş.	Mines at Tavşanlı, 40 kilometers northwest of Kütahya, near Bursa, and near Eskişehir. Plant at Eskişehir.	100 dead-burned magnesite.
Do.	Magnesit A.Ş. (Veitscher Magnesitwerke AG, Austria)	Mine at Margı, 50 kilometers northeast of Eskişehir	80 dead-burned magnesite.

See footnotes at end of table.

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TABLE 2—Continued
TURKEY: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Major commodities		Major operating companies and major equity owners[1 2]	Location of main facilities	Annual capacity
Petroleum and natural gas:				
Crude petroleum thousand 42-gallon barrels		Türkiye Petrolleri Anonim Ortaklığı (TPAO) (Government, 100%)	Production from 41 fields, mostly in Diyarbakır, Gaziantep, and Siirt Provinces	19,500.[e]
Do.	do.	Perenco Plc.	Production from 27 fields in Diyarbakır and Siirt Provinces	5,000.[e]
Do.	do.	Other producers (private sector and in joint venture with TPAO)	Production from 27 fields, mostly in Diyarbakır, Gaziantep, and Siirt Provinces	9,000.[e]
Refined petroleum	do.	Türkiye Petrol Rafinerileri A.Ş. (TÜPRAŞ) (Government, 100%)[4]	Refinery at Batman	7,700 crude input.
Do.	do.	do.	Refinery at Aliağa	70,000 crude input.
Do.	do.	do.	Refinery at İzmit	91,000 crude input.
Do.	do.	do.	OAR refinery at Kırıkkale	35,000 crude input.
Do.	do.	Anadolu Tasfiyehanesi A.Ş. (ATAŞ)	Refinery at Mersin	30,800 crude input.
Natural gas thousand cubic meters		Türkiye Petrolleri Anonim Ortaklığı (TPAO) (Government, 100%)	Çamurlu Field, Siirt Province	25,000.
Do.	do.	do.	Değirmenköy Field in Thrace	80,000.
Do.	do.	do.	Hamitabat Field in Thrace	100,000.
Silver	kilograms	Etibank 100. Yil Gümüş Madeni İşletmeleri Müessesesi Müdürlüğü (Etibank, 100%)	Aktepe Mine near Gümüşköy, 20 kilometers west-northwest of Kütahya	105,000.[e]
Strontium		Barit Maden Türk A.Ş.	Mine at Akkaya, 25 kilometers south of Sivas	100 celestite concentrate.[e]
Sulfur		Keçiborlu Kükürt İşletmesi Müessesesi Müdürlüğü (Etibank, 100%)	Mine at Keçiborlu, 30 kilometers northwest of Isparta	55.
Do.		Türkiye Petrol Rafinerileri A.Ş. (TÜPRAŞ) (Government, 100%)[4]	Recovery plants at company oil refineries	23.
Zinc		Çayeli Bakır İşletmeleri A.Ş. (Inmet Mining Corp., 49%; Etibank, 45%; Gama Endustri, 5%; Gama Holding, 1%)	Çayeli Mine, 85 kilometers east of Trabzon	36 zinc concentrate.
Do.		Çinko Kurşun Metal Sanayii A.Ş. (ÇİNKUR) (Kayseri Maden Metal Tic. A.Ş., 85%)	Zinc-lead smelter at Kayseri	34 zinc, 125 tons cadmium.

[e]Estimated.
[1]Turkish private-sector ownership unless otherwise noted.
[2]Etibank refers to the 100% Government-owned group administered by Etibank Genel Müdürlüğü.
[3]Facility was idle in 1997.
[4]Shares are held by the Public Participation Fund Administration for eventual privatization.
[5]Refined copper output is dedicated to the company's cable and wire operations.

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THE MINERAL INDUSTRY OF

THE UNITED ARAB EMIRATES

By Bernadette Michalski

Hydrocarbons lead the United Arab Emirates[1] (UAE) mineral industry and the economy. Crude petroleum and natural gas accounted for 34.5% of the country's gross domestic product in 1997. The Ministry of Planning reported that oil revenues totaled $13.9 billion[2], down from $14.9 billion in 1996 (Arab Petroleum Research Center, 1998). Abu Dhabi dominates the UAE's hydrocarbon industry, sustaining 84% of crude oil production, 64% of marketed gas production, 94% of crude oil reserves, and 92% of natural gas reserves.

Aluminum and steel from Dubai, ammonia from Abu Dhabi, cement manufactured in six emirates, and chromite from Fujairah were among the minerals produced in the UAE *(See table 1.)* In 1997, Dubai overtook Singapore as the world's leading gold bullion importer and value-added jewelry exporting center. Gold purchases increased by 85% to an estimated 650 metric tons (t) from 350 t in 1996. The surge in consumption was caused by India's easing restrictions on gold imports - (80% of which were obtained from Dubai), the decline in gold prices, and cuts in customs tariffs in other countries (Platt's Metals Week, 1998).

All mineral resources were owned and controlled by the individual emirates and only loosely administered by the Federal Government. The Ministry of Petroleum and Mineral Resources coordinated Federal UAE activities with the international community. The Government continued to encourage the expansion of the country's mineral production capacity. Crude oil production averaged 2.25 million barrels per day (Mbbl/d) in 1997 and was primarily from Abu Dhabi, which produced 2 Mbbl/d. Remaining petroleum and natural gas production was from Dubai and Sharjah. Ras Al-Khaimah realized a portion of the production from the offshore Bukha Field shared with Oman. Umm al-Qaywayn held a 20% share in production from the Mubarak Field in Sharjah. Production exceeded the Organization of Petroleum Exporting Countries (OPEC) quota which limited production from the UAE to 2.16 Mbbl/d. For 1998, the OPEC quota was raised to 2.366 Mbbl/d. In spite of the increased quota Abu Dhabi will have about 400,000 barrels per day (bbl/d) of unused production capacity.

Crude oil, refined petroleum products, natural gas, and aluminum were the principal mineral products exported. Japan, the primary customer for the UAE's mineral exports, absorbed most of Abu Dhabi Gas Liquefaction Co.'s liquefied natural gas (LNG) production and about one-third of the aluminum output and bought more than one-half (1.24 Mbbl/d) of the UAE's more than 2 Mbbl/d crude oil exports in 1997. Chromite ore and gold products fabricated from imported bullion were also exported, primarily to Asia.

The Government was heavily involved in the mineral industry, owning majority shares in the aluminum, fertilizer, natural gas, petroleum production and refining, and sulfur industries. It also had a significant presence in the cement industry. International petroleum companies were heavily involved in crude oil and natural gas development and infrastructure projects in Abu Dhabi. Expatriates accounted for about 75% of the labor force. Ajman granted exploration rights to its entire territory to a Canadian and Norwegian consortium in 1997.

In the metals sector, Dubai Aluminum Co. Ltd. (Dubal) commissioned a 130,000-metric-tons-per-year (t/yr) capacity potline in January 1997, raising total capacity at Dubal to 380,000 t/yr of aluminum. Australia supplied all Dubai's alumina requirements. The smelter's main products are billet, foundry alloy for automotive wheels and component castings, and high-purity ingot for electronics. About two-thirds of the output is shipped to the Far East, and the balance to the Middle East and Europe. The size and infrastructure at the Jebel Ali site could support a 500,000-t/yr-capacity smelter. A sixth 130,000-t/yr-capacity potline is under consideration (Middle East Economic Digest, 1998b).

Chromite mining in Fujairah by Derwent Mining Ltd. of Ireland continued with output exported principally to China and the Netherlands. Other metal operations included the Ahli Steel Co., which is to scrap a 70,000-t/yr steel plant in Ramool, Dubai, to build a new 200,000-t/yr steel plant at Jebel Ali, shifting all manufacturing operations to the industrial center. The new mill is expected to come on-stream in September 1999 and will consist of an electric arc furnace, continuous caster, and rolling mill to produce 200,000 t/yr of 8 to 32-mm rebar, as well as light structural sections and wire rod in coils (Metal Bulletin, 1998). Other metal works included Solo Industries Ltd. in Sharjah, which operated an 800-t/yr lead refinery for scrap recycling, and Lucky Recycling Ltd. in Dubai, which recycled copper scrap.

Ruwais Fertilizer Industries (FERTIL) continued to expand fertilizer exports. FERTIL proposed to increase its ammonia production capacity by 25%, to 500,000 t/yr, and urea production capacity by 15%, to 600,000 t/yr. Smaller fertilizer plants included a 219,000-t/yr plant at Ajman and the 6,000-t/yr Union Kemira plant at Jebel Ali, Dubai. Abu Dhabi National Oil Co.'s (ADNOC) subsidiary, National Chlorine Industries, produced caustic soda, chlorine, and salt at its plant in Umm Al-Nar.

Expansion was underway at Fujairah Cement Industries in Dibba, Fujairah. The Ras Al-Khaimah Cement Co. contracted for the turnkey construction of a 1-million metric tons per year of Portland cement plant at Kywair, Ras Al-Khaimah. The plant completion is expected for 2000. Plant products will be marketed throughout the UAE and abroad (ZKG International, 1997).

The Government encouraged the expansion of hydrocarbon production capacity. The UAE increased sustainable crude petroleum production capacity to 2.6 Mbbl/d in 1997 from 2.3

[1]Comprises the following seven Emirates: Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al-Khaimah, Sharjah, and Umm al-Qaywayn.

[2]Where necessary, values have been converted from Emirian dirhams (Dh) to U.S. dollars at the rate of Dh3.67=US$1.00 in 1997.

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Mbbl/d in 1991. Natural gas production capacity was expanded from 3.5 million to 4.8 million cubic meters per day (Mm^3/d). The expansion was achieved by modernizing onshore and offshore gas extraction and distribution systems. Bechtel Corp. of the United States was part of a joint venture that was contracted to upgrade the gas-processing facilities at Habshan. This $1.3-billion onshore gas project for ADNOC will further development of the Thamama B, C, and F sour gas reservoirs. A projected natural gas flow of 42 Mm^3/d was to be treated to recover condensate and sulfur (Financial Times, 1997).

Domestic and international oil companies' investment in increased production capacity has included drilling infill wells, upgrading wellhead equipment, and adding oil and gas gathering facilities, such as new trunklines, flowlines, and remote manifold stations. To comply with OPEC quota restrictions, the onshore fields in Abu Dhabi were required by the Government to cut back on production, and operations in Dubai and high-cost offshore fields were permitted to produce at higher rates.

Exploration continued in the UAE with Dubai Petroleum Co. conducting marine seismic surveys adjacent to its offshore Fateh Field. Ras Al-Khaimah authorities assigned an exploration license to complete a three dimensional seismic survey of Block B to Atlantis Technology Services and Petroleum Geo Services. The Saleh gas and condensate field was the only hydrocarbon structure in production in Sharjah. About 10 Mm^3/d of natural gas was delivered to Dubai. Additional natural gas requirements are to be satisfied by deliveries from Abu Dhabi and Qatar. Natural gas deliveries to Dubai from Abu Dhabi were expected to commence in 2001 at an initial rate of about 15.3 Mm^3/d. Qatar was also expected to supply natural gas to Dubai from the North Field at the rate of 800 Mm^3/d (Middle East Economic Digest, 1998c).

By yearend 1997, refining capacity increased from 211,000 to 326,000 bbl/d. Sharjah had purchased three mothballed Canadian plants, the first of which came on-stream at an 80,000-bbl/d capacity in late 1997. Feedstock will be from Iran, Kuwait, and Saudi Arabia. Fujairah commissioned a 35,000-bbl/d Fujairah refinery. Crude stock for the refinery was the sour heavy crude from the Saudi/Kuwait Partitioned Zone. Abu Dhabi had two refineries with a combined capacity of 211,000. The Ruwais refinery was rated at 126,000 bbbl/d, and the Umm al-Nar, at 85,000 bbl/d. The Ruwais petroleum refinery was undergoing expansion and modernization. The project will include increasing distillation capacity to 540,000 bbl/d in two stages. In the first stage, two 140,000-bbl/d condensate processing trains will be installed by 2000. These units will process the condensate produced as a result of the gas development underway at the Bab and Asab Fields. In the second stage, a 135,000-bbl/d crude distillation unit will be added. Dubai and Sharjah are both developing refineries. Dubai will have a 18,000-bbl/d refinery for liquified petroleum gas and gasoline.

ADNOC and Borealis have formed a 60%-40% joint petrochemicals venture. A $1 billion petrochemical complex, to be built at Ruwais, will be based on a 600,000-t/yr ethane cracker that will supply feedstock for a 450,000-t/yr Borstar process polyethylene complex. About 150,000 t/yr will be delivered to ADNOC's wholly owned 540,000-t/yr ethylene dichloride plant, also planned at Ruwais. Products from Ruwais will be sold in Asia.

The UAE had proven petroleum reserves of 97.8 billion barrels as of January 1, 1998. Proven natural gas reserves were 5.8 trillion cubic meters. Most of the UAE's hydrocarbon reserves were in Abu Dhabi, the venue for 94% of petroleum reserves and 92% of natural gas reserves (Arab Petroleum Research Center, 1998).

Total installed electricity generating capacity was 5,500 megawatts (MW). A number of gas-fired power and desalinization plants were under construction. The 1998 addition of 600-MW capacity through the installation of four new gas turbines and a 30,000-cubic-meter-per-day (m^3/d) desalination plant at Ruwais is vital in meeting the utility requirements of the expanded Ruwais refinery, the ethylene dichloride complex, and the Abu Dhabi Polyethylene company (Middle East Economic Digest, 1998a).

The UAE's crude oil and natural gas distribution network included extensive coastal petroleum terminals at Ruwais, Jebel Dhanna, Port Zayed, and Umm Al-Nar in Abu Dhabi, Jebel Ali and Port Rashid in Dubai, and in Sharjah. Island or mooring buoy loading facilities were at Abu Al-Bukhoosh, Das Island, Delma Island, Mubarraz, and Zirku Island in Abu Dhabi, Fateh in Dubai, and Mubarak in Sharjah.

Revenues from mineral fuels continued to be reinvested in diversification projects and downstream processing. Increasing domestic consumption of electricity and OPEC limitations on oil production forced the UAE to emphasis natural gas output. Developing natural gas resources ultimately increases exports of condensates that are not subject to OPEC quotas. In 1997, the UAE awarded $2.7 billion in natural gas onshore and offshore enhancement and expansion contracts and $3 billion for the petrochemical industry and the Ruwais petroleum refinery upgrade. In the near term, prospects for LNG sales look less than favorable as the economic downturn in Japan and the Republic of South Korea flattens demand and term contracts may be renegotiated.

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TABLE 1
UNITED ARAB EMIRATES: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
Aluminum, metal, primary ingot		242,264	246,890	239,900	274,000	398,000 3/
Cement, hydraulic e/ 4/	thousand tons	4,000	5,000	5,918 3/	6,000	6,000
Chromite, gross weight		19,000	55,000	37,000	56,000	61,000 3/
Fertilizer materials:						
Ammonia:						
Gross weight e/		372,000	347,500	441,000	405,000	455,000
N content		305,600	286,500	362,700	331,200	372,500 3/
Urea:						
Gross weight e/		520,000	450,000	575,000	490,000	600,000
N content		259,700	230,000	293,600	258,400	299,600 3/
Gas, natural:						
Gross	million cubic meters	31,630	34,360	40,860	46,530	48,500 3/
Dry	do.	22,930	25,820	31,320	36,250	37,300 3/
Gypsum e/	thousand tons	95	95	90	90	90
Lime e/	do.	45	45	50	50	50
Natural gas plant liquids e/	thousand 42-gallon barrels	58,000	80,000	100,000	110,000	110,000
Petroleum:						
Crude	do.	800,000	792,000	800,500	831,470	845,340 3/
Refinery products:						
Gasoline	do.	11,132	11,970	12,738	12,446	13,000
Kerosene	do.	9,700	10,110	21,243	20,330	21,000
Distillate fuels	do.	19,890	21,681	24,345	24,090	24,500
Residual fuels	do.	19,856	21,863	12,995	16,717	17,000
Other	do.	10,100	10,475	12,665	12,154	12,000
Total	do.	70,678	76,099	83,986	85,737	87500
Steel e/		70,000	70,000	70,000	70,000	70,000
Sulfur, byproduct: e/						
From petroleum refining		24,000	24,500	26,000	26,000	26,000
From natural gas processing		225,000	225,500	230,500	233,000	210,000
Total		249,000 3/	250,000	256,500	259,000	236,000

e/ Estimated. r/ Revised.
1/ Table includes data available through December 1, 1998.
2/ In addition to the commodities listed, crude industrial minerals, such as common clays, diabase, gravel, limestone, marble, sand and shale, presumably are produced, but output is not reported, and general information is inadequate to make reliable estimates of output levels.
3/ Reported figure.
4/ Includes white cement.

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THE MINERAL INDUSTRY OF

YEMEN

By Bernadette Michalski

Crude oil production and natural gas liquids recovered from associated natural gas were Yemen's principal mineral industries. Other mineral output included cement, dimension stone, gypsum, and salt. About 20 hydrocarbon exploration agreements were in force in 1997. The Jannah and the Shabwa East Fields came on-stream during the later part of the year and should account for at least a 20% increase in the nation's petroleum output in 1998. The Yemen LNG Company was formed in 1997 to build and operate a 5-million metric ton-per-year-capacity liquefied natural gas (LNG) plant. Feedstock for the plant was to be chiefly natural gas from the Marib-Al Jawf area. LNG exports, principally to Asia and Europe, were scheduled to begin in 2001. For more extensive coverage of the mineral industry of Yemen, see the 1996 Minerals Yearbook, Volume III, International Review of Africa and the Middle East.

TABLE 1
REPUBLIC OF YEMEN: PRODUCTION OF MINERAL COMMODITIES 1/

Commodity		1993	1994	1995	1996	1997 e/
Cement	thousand metric tons	800	500	1,088 r/	1,000 e/	1,200
Gypsum e/	metric tons	90,000 2/	80,000	80,000	80,000	80,000
Natural gas: e/						
Gross	million cubic meters	90,000	100,000	100,000	100,000	100,000
Liquids	thousand 42-gallon barrels	2,600 2/	2,600	2,600	2,600	2,600
Petroleum:						
Crude	do.	87,600	122,275	127,750	129,200	135,000 2/
Refinery products: e/						
Gasoline	do.	10,000 2/	8,000	10,000	10,000	10,000
Kerosene	do.	4,500 2/	2,500	3,500	3,500	3,500
Distillate fuel oil	do.	13,000 2/	10,500	11,500	11,500	11,500
Residual fuel oil	do.	15,500	12,000	15,000	15,000	15,000
Other	do.	2,000 2/	1,000	2,000	2,000	2,000
Total	do.	45,000	34,000	42,000	42,000	42,000
Salt e/	metric tons	110,000	110,000	110,000	110,000	110,000
Stone, dimension e/	cubic meters	410,000	410,000	410,000	410,000	410,000

e/ Estimated. r/ Revised.
1/ Table includes data available through June 15, 1998.
2/ Reported figure.

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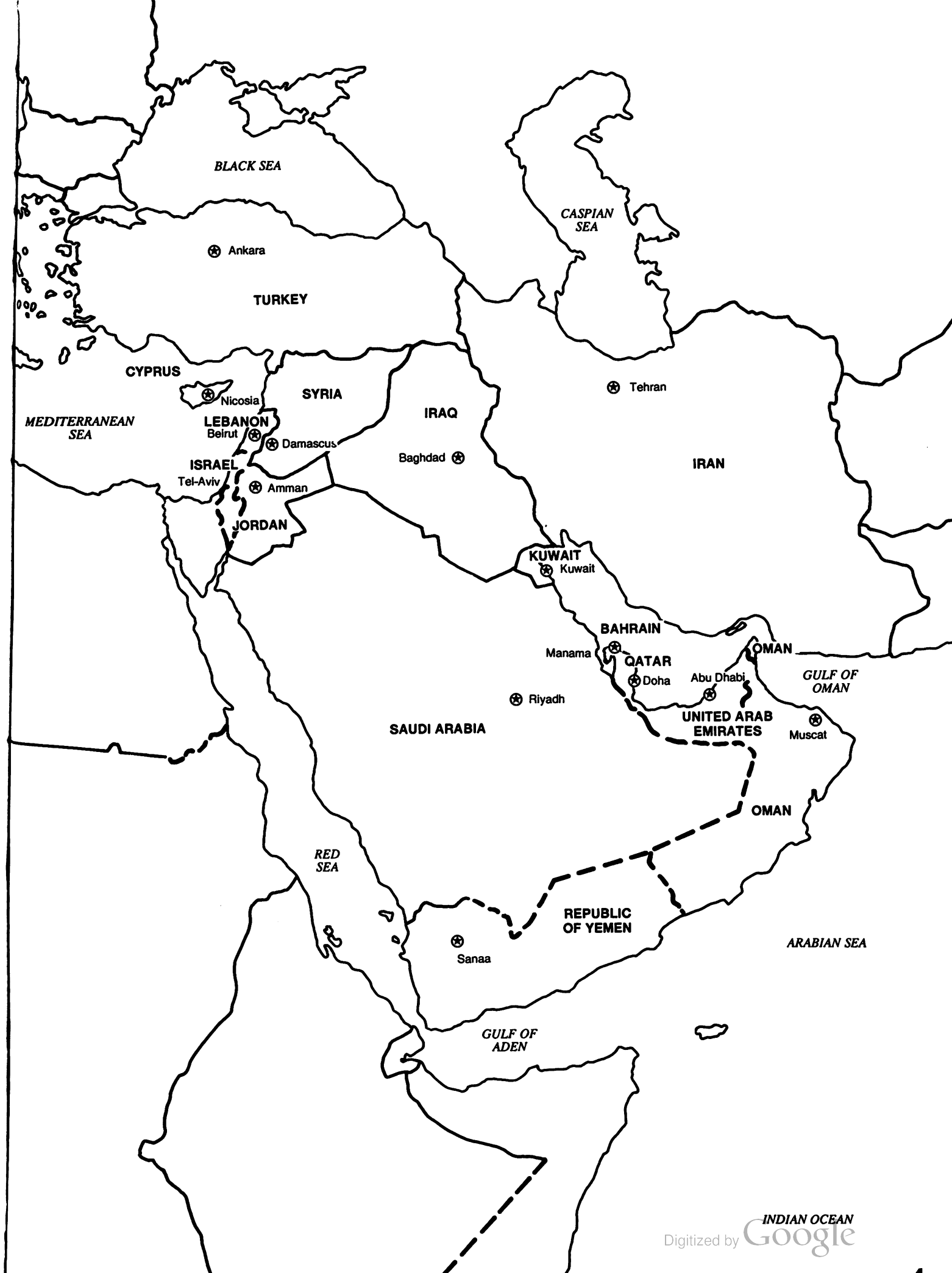

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